

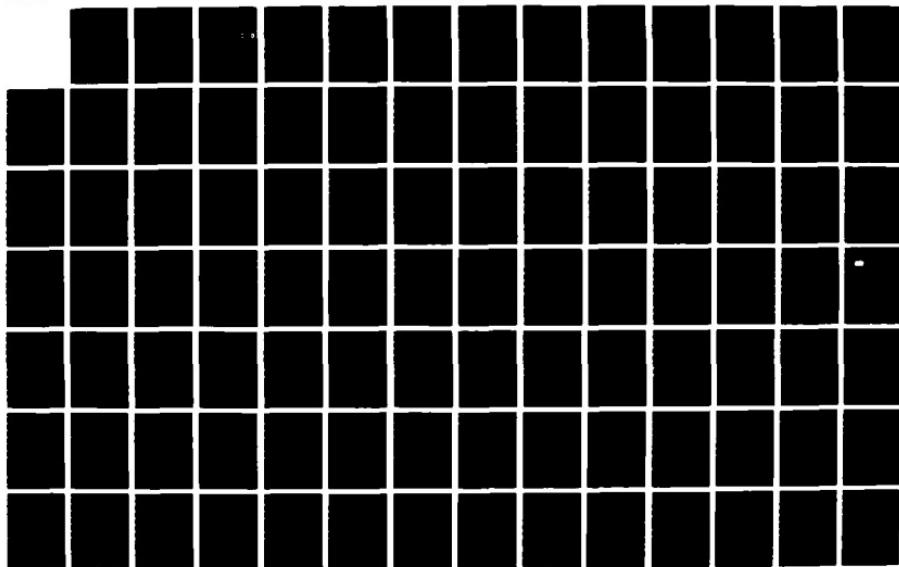
NO-A187 836

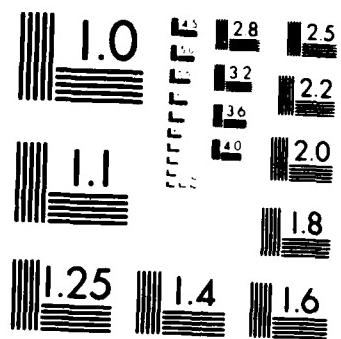
AN INVESTIGATION OF EDUCATIONAL REQUIREMENTS IN
FACILITIES ENGINEERING(U) AIR FORCE INST OF TECH
WRIGHT-PATTERSON AFB OH SCHOOL OF SYST. D M KREAG
UNCLASSIFIED SEP 87 AFIT/GEM/LSM/875-14

1/2

F/G 5/6

NL



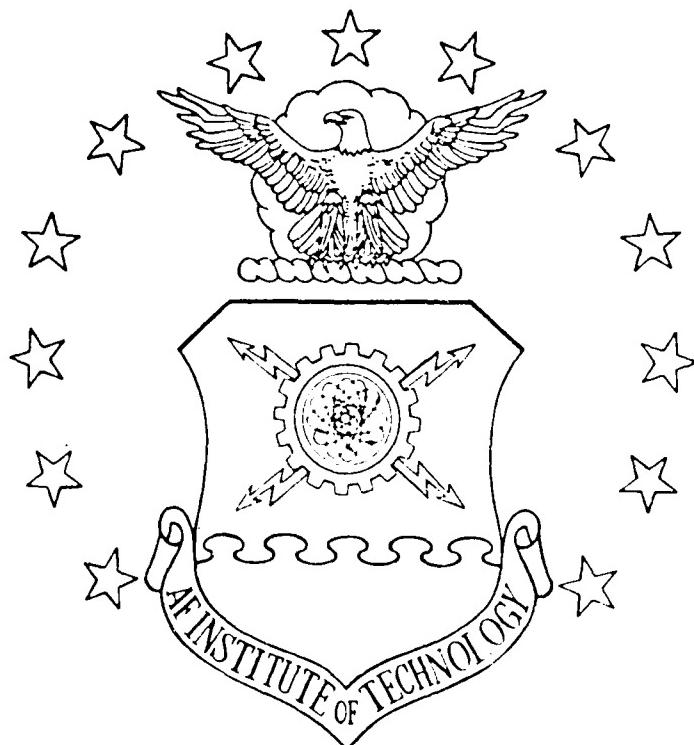


MICROCOPY RESOLUTION TEST CHART
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

DTIC FILE COPY

(c)

AD-A187 836



DTIC
SELECTED
JAN 04 1988
S H

AN INVESTIGATION OF EDUCATIONAL
REQUIREMENTS IN FACILITIES ENGINEERING
THESIS

DAVID M. KREAG
Captain, USAF

AUTOD/CBM/EGM/MS/1A

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

87 12 22 035

(2)

AFIT/GEM/LSM/87S-14

DTIC
SELECTED
S JAN 04 1988 D
H

AN INVESTIGATION OF EDUCATIONAL
REQUIREMENTS IN FACILITIES ENGINEERING

THESIS

DAVID M. KREAG
Captain, USAF

AFIT/GEM/LSM/87S-14

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification _____	
By _____	
Distribution/ _____	
Availability Codes _____	
Dist	Avail and/or Special
R-1	

Approved for public release; distribution unlimited

The contents of the document are technically accurate, and no sensitive items, detrimental ideas, or deleterious information is contained therein. Furthermore, the views expressed in the document are those of the author and do not necessarily reflect the views of the School of Systems and Logistics, the Air University, the United States Air Force, or the Department of Defense.

AFIT/GEM/LSM/87S-14

AN INVESTIGATION OF EDUCATIONAL
REQUIREMENTS IN FACILITIES ENGINEERING

THESIS

Presented to the Faculty of the School of Systems and Logistics,
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Engineering Management

David M. Kreag, B.S.

Captain, USAF

September 1987

Approved for public release; distribution unlimited

Acknowledgments

I wish to express my love and appreciation to my wife, Eleanor, for her patience and understanding throughout this academic year.

A special thanks is extended to Mr. Tom Klug, Director of Association Development for the AIPE Foundation, who paved the way for the nominal support of the research by the Foundation and provided me with a mailing list to survey the civilian respondents. Also, I appreciate the time spent on the survey by the civilian and military respondents.

Finally, I thank Maj. Hal Rumsey, my thesis advisor, and Dr. Robert Weaver, my thesis reader, for their time, expertise, and guidance in making this thesis possible.

David M. Kreag

Table of Contents

	Page
Preface	ii
List of Tables	v
Abstract	vi
I. Introduction	1
Background	1
Specific Problem	3
Definition of Terms	3
Research Questions	4
Scope	5
II. Literature Review	6
Introduction	6
Background	6
Educational Programs	7
Program Assessment	7
Comparison of Subject Matter	8
Summary	11
III. Methodology	12
Introduction	12
Interviews	12
Academic Subject Generation	13
Survey	13
Survey Development	13
Population and Sample	16
Data Collection Plan	18
Research Question #1	18
Research Question #2	19
Research Question #3	19
Research Question #4	19
Analyses	21
IV. Results	22
Introduction	22
Demographic Results	22
Research Question #1	28
Research Question #2	28
Research Question #3	31
Research Question #4	33

	Page
V. Discussion and Conclusions	35
Introduction	35
Demographics	35
GEM Program	36
Previous Survey Results	36
Improvement to Program	36
Existing GEM Subjects	39
Potential GEM Inclusions	39
Summary	40
Appendix A: Information Request Letter	42
Appendix B: Organizations Contacted	43
Appendix C: Survey Package for Civilian Sample . .	44
Appendix D: Survey Package for Military Sample . .	56
Appendix E: AFIT Data Collection Form	68
Appendix F: GEM Course Titles	70
Appendix G: Responses to the Three Questions (By Military Rating)	71
Appendix H: Importance and Need Ratings of Academic Subjects (By Military Rating)	73
Appendix I: T-test	75
Appendix J: Programs and Data	77
Bibliography	99
Vita	101

List of Tables

Table		Page
I.	Facility Management Programs	8
II.	Required & Elective Courses	9
III.	Academic Subjects	14
IV.	Responses by Position	23
V.	Responses by Rank	24
VI.	Responses by Type of Company	24
VII.	Responses by Experience	25
VIII.	Responses by Education	26
IX.	Responses by Civilian Undergraduate Education .	27
X.	Responses by Budget	27
XI.	Responses to the Three Questions by Category .	29
XII.	Importance & Need Ratings of Academic Subjects (By Military Rating)	30
XIII.	Need & Importance by Category	31
XIV.	Academic Subjects Rated Significantly Higher by Civilians	33
XV.	Academic Subjects Rated Important by Either Military or Civilian Respondents . .	37

Abstract

This research identified academic subjects considered important by facility managers in order to improve the Air Force's educational program on facility management. From the literature review, 59 academic subjects were incorporated into a survey to test for perceived need and importance. Two populations of facility managers were surveyed to compare military and civilian perspectives, using a 7-point Likert scale.

The results indicated that professional ethics was the single most important subject. Construction management, life cycle costing, leadership, technical writing, communication, statistical analysis, strategic planning, and public speaking were rated with means above 5 (important) by both military and civilian respondents. Seventeen other academic subjects were rated by either the military or civilian respondents as important. Of the 59 academic subjects, 35 (59%) showed no significant differences between the means of the military and the civilian respondents.

Twelve academic subjects not specifically included in the Air Force's Graduate Engineering Management curriculum were considered important by either the military or the civilian respondents: professional ethics, construction management, strategic planning, maintenance management,

budget preparation, building fire protection, building programming, civil engineering, mechanical engineering, electrical engineering, safety engineering, and value engineering. Inclusion of these academic subjects may improve the overall program. They could be incorporated into already existing courses, or made available as additional elective courses in the GEM curriculum.

AN INVESTIGATION OF EDUCATIONAL
REQUIREMENTS IN FACILITIES ENGINEERING

I. Introduction

This research will examine the perceptions of need and importance of academic subjects by both civilian and military facility managers. By comparing civilian facility managers' perceptions to the military's views, an insight may be gained for improvement in the facilities engineering program. The following sections discuss the background, specific problem, definition of terms, research questions, and scope of this research.

Background

The civil engineering officer is the Air Force's facility manager. Private sector facility managers do much the same thing for a company as civil engineering officers do for the Air Force. Both Air Force and private sector facility managers are responsible for maintenance of commercial and industrial type facilities, although the types of facilities may differ between the Air Force and the private sector due to location and mission.

The mission of the Air Force Civil Engineer is to "support . . . the Air Force mission and its people . . . [through the] operation, maintenance, and improvement of Air Force real and installed properties" (4:9). The civil

engineer manages the maintenance and repair of all base facilities and real property installed equipment, as well as the design and construction of new facilities.

A look at the mission of civilian facility managers reveals that indeed there are similarities. Examples of typical mission statements from three different private sector firms are as follow:

- 1) At Digital Equipment Corporation, the plant engineer's major functions include maintenance of facilities and equipment, construction, and space planning. (8:28)
- 2) The Nissan motor plant near Smyrna, Tennessee, has its plant engineering department organized under three responsibility areas:

Plant energy systems, which includes plant utilities and plant systems

Central services, which includes maintenance planning and control, central maintenance, and environmental engineering

Engineering design and construction, which includes facilities engineering and construction projects. (20:58)

- 3) Plant Engineer Glen E. Flook, head of Frito-Lay's Casa Grande, Arizona, Engineering and Technical Services group said:

We operate the plant waste water treatment system, boilers, utilities, and fire protection systems; provide technical support; and keep all the maintenance records. (15:49)

All of the above private sector facility management job descriptions are similar in scope to what the civil engineering officer does on an Air Force base. Only three mission statements were listed to compare with the military mission statement; however, similar mission statements from private sector facility managers can be found in various periodicals on facility management.

Specific Problem

Since the private sector and the Air Force have similar mission statements covering facility management, they should rely on a common body of knowledge which might improve the Air Force's education program on facility management. Specifically, this research will focus on the academic subjects that private sector facility managers and civil engineering officers consider important for facility management. Individual educational programs will not be looked at. However, a compiled list of subject areas considered beneficial to the Air Force's educational program on facility management will be included.

Definition of Terms

1. Facility Manager--a person responsible for the management of the maintenance, repair, design, development, and construction of facilities and utility systems.
2. Plant Engineer--a person working in the private sector with the title of plant engineer conducting facility management type work.

3. Civil Engineering Officer--an Air Force officer with an Air Force Speciality Code of 55XX. Activities include "design and project preparation, drafting, surveying, planning, feasibility studies, construction surveillance, maintenance and repair, utilities operation, facility energy management, environmental control, land management, real estate and real property accounting, work measurement and analysis, and related installation support services" (5:A15-5).

4. GEM Program (Graduate Engineering Management)--the curriculum required to achieve a Master of Science degree in Engineering Management at the Air Force Institute of Technology (AFIT).

5. AIPE Foundation (American Institute of Plant Engineers)--the education and research arm of the American Institute of Plant Engineers.

Research Questions

1. What are some of the academic subjects in which facility managers have been educated?
2. Do facility managers perceive a need for these academic subjects?
3. What academic subjects are rated highly by civil engineering officers and/or private sector facility managers?
4. Are there differences in how private sector facility managers and Air Force civil engineering officers rate these academic subjects?

Scope

The scope of this study follows these guidelines:

1) Academic subjects rather than the method of education will be focused upon. Academic subjects will include the knowledge, subjects, and abilities that facility managers see a need for in their jobs. The 59 academic subjects used are not an exhaustive list of all possible academic subjects that facility managers perceive as important.

2) A mailed survey was used, which limited the depth of knowledge gained from the study, and which also had a greater chance of misinterpretation than a personal or telephone interview.

3) The populations were limited to recipients of AIPE Facilities Management, Operations & Engineering magazine and past Air Force GEM students who graduated within the last five years. Samples from these populations were used to answer the research questions.

Ultimately, a list of subject areas considered important in the private sector was compiled so a comparison could be made with the Air Force's GEM program.

II. Literature Review

Introduction

This chapter will first give a general assessment of current education and training opportunities throughout all industries. Next, the Air Force's educational opportunities for civil engineering officers will be reviewed. Then a comparison will be made between the GEM, average American, average foreign, and International Facility Management Association (IFMA) curricula. Finally, a summary will explain how all of this information relates to the research.

Background

It is a costly venture to educate personnel. Generally, companies pay at least 70 percent of the educational expenses for courses that an employee voluntarily attends (10:36). Eighty-one percent of the respondents of Training magazine's 1986 Industry Report indicated that organizations sponsor education and training of personnel in hopes that they will lead to better job performance. Management subjects, technical subjects, supervisory subjects, communication subjects, and new methods or procedural courses were the top five subject areas taught throughout all the industries surveyed in the report (12:57).

Educational Programs

Air Force educational opportunities for facility managers include civilian institution graduate programs and a resident graduate degree program. The civilian institution graduate programs consist of engineering management and specific engineering areas such as architectural, civil, electrical, industrial, and mechanical (3:290). The resident graduate degree program for Air Force civil engineering officers is the GEM program at AFIT, which helps prepare the civil engineering officer for mid-level management positions in maintenance and repair of base facilities. Approximately 20-25 Air Force Officers per year attend the GEM program. This represents less than 2 percent of the lieutenants, captains, and junior majors in the civil engineering career field (19). Besides the GEM program, a range of professional civil engineering short courses is offered through the School of Civil Engineering and Services.

The GEM program at AFIT is not the only graduate level engineering management program. As of October 1984, 66 master of science level engineering management programs were offered at various colleges and universities in the United States (17:A-4).

Program Assessment. AFIT conducts two surveys annually to assess course effectiveness. One survey is the School of Systems & Logistics Annual Evaluation Report and the other

is the Graduate Post Course Survey. Fiscal year 1985 GEM students were surveyed upon course completion and asked which subjects they felt were important. The five subjects found to be the least important were operations research, statistical concepts, scientific research, accounting concepts, and evaluating distribution systems (1:69-70).

Comparison of Subject Matter. A comparison between the GEM, IFMA, and the average American and foreign engineering management curricula was made based on a 1984 paper on facility management disciplines presented at the International Congress on Technology and Technology Exchange. The average American and foreign engineering management curricula were divided into six categories (quantitative, qualitative, financial, project, engineering, and functional) as shown at Table I.

TABLE I
FACILITY MANAGEMENT PROGRAMS

<u>Category</u>	<u>American</u>	<u>Foreign</u>	<u>IFMA</u>	<u>GEM</u>
Quantitative	30%	28%	17%	16%
Qualitative	19%	17%	29%	16%
Financial	15%	19%	12%	5%
Project	9%	5%	3%	14%
Engineering	4%	1%	0%	0%
Functional	23%	30%	39%	21%

(3:181-182, 14:A-III, 17:A10-11)

The GEM program shows 16 percent quantitative, 16 percent qualitative, 5 percent financial, 14 percent project, no engineering, and 21 percent functional.

Functional courses are those that pertain to the day-to-day operations of the job and do not fall within the other categories. The GEM program has a large project percentage because of the requirement for a thesis (14 percent). It also shows less emphasis in the financial percentage (5 percent) compared to the other programs. All three programs list the quantitative and functional areas with the highest percentages, which seems to support the idea that these two categories are the most important.

The percentages of required and elective courses of the curricula were also compared, as shown at Table II.

TABLE II
REQUIRED & ELECTIVE COURSES

	<u>American</u>	<u>Foreign</u>	<u>IFMA</u>	<u>GEM</u>
Required	55%	82%	80%	82%
Electives	45%	18%	20%	18%

(3:181-182, 14:A-III, 17:A10-11)

The GEM program follows an 80 percent required 20 percent elective course program, like the foreign program. (See Appendix F.) The average American program offers a lower percentage of required courses (55 percent) and a higher percentage of electives (45 percent). This could be the result of the specific area coverage in the foreign and GEM courses. The GEM course is specifically designed for a civil engineering officer or civilian counterpart operating in the Air Force environment. The average engineering

management course in American programs probably offers more electives than the other programs due to more of a broad coverage that allows individuals to specialize in the areas that they are interested in rather than having to complete a required set of courses.

Facility management can be divided into its component parts. "Research has shown that 80-95 percent of facilities managers perform common tasks" (14:A-III). These nine common tasks are as follow:

- 1) Real Estate Acquisition and/or Disposal
- 2) Annual Facility Planning
- 3) Facility Financial Forecasting and Budgeting
- 4) Long Range Facility Planning
- 5) Interior Space Planning, Work-Place Specifications, Installation and Space Management
- 6) Architectural and Engineering Planning & Design
- 7) New Construction and/or Renovation Work
- 8) Maintenance and Operations Management of the Physical Plant
- 9) Tele-communications, Integration, Security, and General Administrative Services

(14:A-III)

Since these tasks are common to all facility managers, it would be expected that education in related subjects should be of major importance toward effective job performance.

Summary

Education is a costly endeavor, but is conducted for better job performance. The Air Force, like most employers, pays educational costs to better prepare its employees. The civil engineering officer has many paths of education. There are the civilian institution program, resident GEM program, and AFIT's short courses. The GEM program is specifically designed for the civil engineering officer operating in the Air Force environment. There are many engineering management courses offered, some structured similarly to the GEM program. A comparison of other engineering management programs with the GEM program was conducted to search for improvements that may be incorporated. Specifically, academic subjects included in these engineering management programs were identified, to be incorporated into the survey which is described in the next section.

III. Methodology

Introduction

This chapter describes the methodology used in the research. This research focuses on how private sector facility managers and civil engineering officers perceive various academic subjects in relation to their job performance. Ultimately, a list of academic subjects considered important by these groups will be compared.

Interviews

Mr. Tom Klug, the Marketing Manager for AIPE Facility Management, Operations & Engineering, sees the future trend on education of facility managers to be from general to more specific subjects (functional). According to Klug, employers have been burdened with educating new employees on specific job tasks. He predicts a shift to a more useful education with the merging of theory and reality in colleges and universities through the co-op programs. He also predicts that more qualitative management courses will be emphasized (16).

The Assistant GEM Program Manager compared the GEM program to a few other Engineering Management programs being taught at civilian institutions, and thought they were very similar. The only area where he saw a lack was in human behavior and people subjects (qualitative) (9).

Academic Subject Generation

Letters were sent to various people and organizations involved with facility managers and plant engineers in the private sector. A copy of the letter and a listing of the organizations that responded to the letter are included at Appendices A and B. From their correspondence and from the literature, a list of academic subjects was compiled, as shown at Table III on the following page.

Survey

The survey instrument was developed to collect data on what academic subjects were deemed important by facility managers. No existing data base was available for study. The survey method was chosen because it was the most economical method available for collecting the required data. Two separate surveys were conducted to gather information on the academic subjects which private sector facility managers and past AFIT Graduate Engineering Management students believe are important in their jobs. A random sampling method was used to obtain a representative sample of the private sector facility managers. A census of past GEM students (Air Force military members still in service who graduated within the last five years) was undertaken.

Survey Development. The development of the survey questions was based on previous work by Lyman W. Porter and Edward E. Lawler (18). Their methodology requires three

TABLE III

Academic SubjectsQuantitative

- | | |
|------------------------|-------------------------|
| 1) Linear Programming | 2) Network Modeling |
| 3) Simulation Modeling | 4) Decision Theory |
| 5) Forecasting | 6) Queuing Theory |
| 7) Inventory Planning | 8) Statistical Analysis |

Qualitative

- | | |
|------------------------|---------------------------|
| 9) General Management | 10) Organizational Theory |
| 11) Behavioral Science | 12) Strategic Planning |
| 13) Leadership | 14) Personnel Management |
| 15) Master Planning | |

Financial

- | | |
|---------------------------|--------------------------|
| 16) Managerial Accounting | 17) Cost Accounting |
| 18) Engineering Economy | 19) Financial Management |
| 20) Budget Preparation | 21) Building Programming |
| 22) Life Cycle Costing | |

Project

- | | |
|------------------------|--------------------|
| 23) Project Management | 24) Group Projects |
|------------------------|--------------------|

Engineering/Architecture

- | | |
|-----------------------------|------------------------------|
| 25) Civil Engineering | 26) Mechanical Engineering |
| 27) Electrical Engineering | 28) Industrial Engineering |
| 29) Architectural Design | 30) Interior Design |
| 31) Computer Systems Design | 32) Safety Engineering |
| 33) Value Engineering | 34) Energy Efficient Designs |

Functional

- | | |
|------------------------------|-----------------------------|
| 35) Computer Science | 36) Information Systems |
| 37) Computer Aided Design | 38) Computer Room Design |
| 39) Communication | 40) Public Speaking |
| 41) Technical Writing | 42) Business Law |
| 43) Marketing | 44) Quality Control |
| 45) R & D Management | 46) Innovation Techniques |
| 47) Entrepreneur | 48) Professional Ethics |
| 49) Labor Relations | 50) Collective Bargaining |
| 51) Public Policy | 52) Contract Policy |
| 53) Building Fire Protection | 54) Real Estate Acq & Disp |
| 55) Installation & Space Mgt | 56) Construction Management |
| 57) Maintenance Management | 58) Facility Operations |
| 59) Energy Management | |

(2:A1-25+, 3:181-182, 14:A-III)

questions per academic subject. The first two questions are used to assess need, while the third assesses importance.

The survey questionnaire consists of subject areas which were assessed based on need, or the amount of difference between how much there is now and how much there should be. In addition, the importance of the subject was also measured. For each area, three questions were asked:

- a) How much are you able to apply now?
- b) How much should be applicable to your position?
- c) How important is this to you?

Need is calculated by subtracting the score of how much there should be from how much there is now ($b - a$). A positive number indicates that a need is seen, while a negative number indicates that too much emphasis is placed on the subject; a zero indicates that there is a good balance in this area.

A 7-point Likert scale was used on each question, with a 1 as the minimum amount and a 7 as the maximum amount. The breakdown of the scale is as follows:

Minimum	Less Than Little	Average	Average	More Than Great	Deal	Maximum
1	2	3	4	5	6	7

A pretest was conducted in order to determine validity of the survey. Validity is the concept that the survey instrument is being interpreted by the respondents in the desired way and measures what is intended to be measured.

Eight AFIT faculty members from the School of Civil Engineering and Services responded to the questionnaire, examined it, and made comments for improvement. These people were selected due to their experience in civil engineering and with surveys. The "expert" review added to the credibility of the survey instrument to ask what was intended to be asked. Comments from the pretest were used to develop the final survey.

Population and Sample

The first population consists of the current recipients of the AIPE's periodical Facilities Management, Operations & Engineering. This group was chosen to represent the civilian facility managers due to their relative ease of inclusion. A larger group would have been desirable, but would have been too costly and time-consuming. The Business Publications Audit of Circulation, Inc., found that the number of recipients during the May/June issue was 8,173, 53.3 percent in manufacturing and 46.7 percent in non-manufacturing industries. Using this population, the sample size was determined from the following general formula:

$$n = \frac{N(z^2)(p(1-p))}{1(N-1)(d^2)+(z^2)(p(1-p))}$$

where n= sample size
N= population size
p= maximum sample size factor (.50)
d= desired tolerance (10%)
z= factor of assurance (1.282) for 90% confidence level.

(13:11-14)

The maximum sample size factor is determined to be 0.50 because the true proportion to be estimated is not known. "To get around this difficulty, we shall make use of the fact . . . that $p(1-p) = 1/4 - (p-1/2)^2$ and, hence, that the maximum value of $p(1-p)$ is $1/4$." (11:239) Hence, a conservative estimate of 0.50 is used when the true value of p is unknown.

The desired tolerance is determined prior to collection of data. The determination is based on how much error is acceptable. The error is the percentage of deviation either positive or negative from the actual population statistics. The factor of assurance is obtained by subtracting one minus (α) and looking in the normal distribution tables to get (z).

The sample size determined by the formula was 40.9. Two hundred surveys were sent to insure that the actual number returned would be 41 or greater. A 90 percent confidence level means that the statistics generated from the answers received are representative of the population, within a tolerance of plus or minus 10 percent (13:11).

The second population consisted of the military members still in service who graduated from the Air Force Institute of Technology GEM program within the last five years. Using this population of 115 military members, a census was conducted due to the small size of the population. Even though a census theoretically yields a 100 percent

confidence level, the previous general formula was used as a guide to determine adequacy of response to the census.

Changing the population size to 115, a sample size of at least 31 would be enough for a 90 percent confidence level. This assumes that the 31 respondents are randomly selected, when in reality they are self-selected. Therefore, if 31 surveys are returned, at least a 90 percent confidence level would be achieved.

Data Collection Plan

The mailed survey packages consisted of a cover letter, 10-page survey, AFIT data collection form (AFIT Form 11 E, Jan 85), and a pre-addressed, postage-paid, return envelope (See Appendices C, D, and E). The military officers were given four weeks to respond, while the civilians had seven weeks to respond. The civilians were given longer to respond because of previous low responses to surveys.

The AFIT data collection forms were gathered up to 20 June 1987 including forms that contained incomplete data. Additional comments made by the respondents were collected and used in the analyses wherever feasible.

Research Question #1. What are some of the academic subjects in which facility managers have been educated? From the literature review, the average Engineering Management curriculum contains courses in six broad categories (quantitative, qualitative, financial, project, engineering, and functional). Subjects were then compiled

to be included in these six categories that were thought to be potentially important academic subjects of facility managers. With the assistance of the GEM Program Manager, 59 academic subjects were incorporated in the survey and were classified into the six broad categories mentioned above.

Research Question #2. Do facility managers perceive a need for these academic subjects? Means were calculated for each question (a, b, and c) and listed by academic subject and category. Then, need (b - a) was calculated for each academic subject and category.

Research Question #3. What academic subjects are rated highly by civil engineering officers and/or private sector facility managers? This research question was answered by rank ordering the academic subjects according to the importance of the two samples and comparing their results. The following rating scale was used in the interpretation of the importance:

Very Little Or None	Below Little	Average	Average	Important	Very Important
-----	-----	-----	-----	-----	-----
1+	2+	3+	4+	5+	6+

Research Question #4. Are there differences in how private sector facility managers and Air Force civil engineering officers rate these academic subjects? This research question was answered by conducting a t-test and a rank order correlation on the importance of the military and civilian respondents.

The t-test was used to check for a significant difference between means. A two sample t-test with the more conservative separate variance estimate was used. A separate variance estimate means that both population variances are not considered to be equal, and are therefore estimated by their respective sample variances. If, however, they were considered to be equal, then a single pooled variance estimator would result from the two sample variances. The separate variance estimate is a more conservative approach because the assumption that the two population variances are equal was not made (6:288).

In order to conduct this type of a "test of means," one assumption is necessary. Both populations require normality. A P-value was used to check against the chosen 95 percent level of statistical significance. A P-value smaller than 0.05 would lead to the rejection of the null hypothesis that the two means are equal, where a P-value larger than 0.05 would lead to the acceptance that the two means are equal (6:247,292).

The rank order correlation was conducted to find if a linear relationship exists between the two sets of ranks generated from the military and civilian respondents on the importance of the 59 academic subjects. The correlation gives an overall measure of how similarly the civilian and military respondents rated the academic subjects. Values from a rank order correlation can range between +1 to -1.

"Positive values indicate that 'high ranks tend to be associated with high ranks'; negative values indicate that 'high ranks on one variable tend to be associated with low ranks on the other'" (7:341). A rank order correlation of one would imply a perfect linear relationship between sample ranks of all 59 academic subjects, while a rank order correlation of zero would imply no correlation.

Analyses

The statistical measures applied to the data were the means, standard deviations, and frequency histograms. Copies of the programs used to answer the research questions are listed in Appendix J. The programs consist of a program for the military respondents and the data, a program for the civilian respondents and the data, a t-test program, and a rank order correlation program. The rank order correlation program was written in SAS. All other programs were written in SPSSX.

IV. Results

Introduction

This chapter includes the description of the demographic characteristics of the respondents and an illustration of the results of the analysis on the survey data.

Demographic Results

Two populations were surveyed, with a total of 315 surveys. Two hundred surveys were sent to the recipients of AIPE Facilities Management, Operations & Engineering, and 115 surveys were sent to Air Force GEM students who graduated within the last five years. Of the 200 surveys sent to the randomly sampled civilian facility managers, 65 (32.5 percent) were returned by the cutoff date. Of the 115 surveys sent to the civil engineering officers, 67 (58.3 percent) were returned by a given cutoff date. The military officers were given four weeks to respond, while the civilians had seven weeks to respond. Sample sizes of at least 41 civilians and 31 military were required to achieve the desired 90 percent confidence level that the samples were true representations of the populations. Since 65 civilians and 67 military responded, at least a 90 percent confidence level was achieved.

Table IV shows that over half the respondents are in middle management positions; 52.2 percent are military and

58.5 percent are civilians. More of the military (16.4 percent) than of the civilian (13.8 percent) respondents were in upper management positions. More of the civilian (16.9 percent) than of the military (7.5 percent) respondents were in supervisory positions. Engineering positions were represented equally by the military (10.4 percent) and the civilian (9.2 percent) respondents. More military (13.4 percent) did not respond to this question than the civilian (1.5 percent) respondents. Some military respondents did not feel that they fit in any of the categories provided in the survey so they wrote the following positions on the survey form: Staff Officer, Military Construction Program Manager, Site Civil Engineer, Faculty Instructor, Air Staff Officer, and Instructor.

TABLE IV
RESPONSES BY POSITION

<u>Position</u>	<u>Frequency</u>		<u>Percent</u>	
	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>
Upper Management	11	9	16.4	13.8
Middle Management	35	38	52.2	58.5
Supervisor	5	11	7.5	16.9
Engineer	7	6	10.4	9.2
Unspecified	9	1	13.4	1.5
TOTAL	67	65	100.0	100.0

Table V shows that the predominant rank of the military responding to the survey is captain (80.6 percent). Also, majors represented 16.4 percent of the respondents, and three percent of the respondents left this area blank. The

ranks indicate middle management positions, which correspond to the majority (52.2 percent) of the military claiming middle management positions from the previous table.

TABLE V
RESPONSES BY RANK

<u>Rank</u>	<u>Frequency</u>	<u>Percent</u>
Lt. Colonel	0	0.0
Major	11	16.4
Captain	54	80.6
Lieutenant	0	0.0
Unspecified	<u>2</u>	<u>3.0</u>
TOTAL	67	100.0

Table VI shows that the majority of the civilians responding are employed by a manufacturing industry (66.2 percent). The non-manufacturing industry is represented by 30.8 percent of the respondents; 3.1 percent of the respondents left this area blank.

TABLE VI
RESPONSES BY TYPE OF COMPANY

<u>Type Company</u>	<u>Frequency</u>	<u>Percent</u>
Manufacturing	43	66.2
Non-Manufacturing	20	30.8
Unspecified	<u>2</u>	<u>3.1</u>
TOTAL	65	100.0

Table VII shows the majority of the military respondents falling equally into the 0-6 year and the 7-10 year experience range (41.8 percent), while the civilians

are distributed throughout all categories with the highest frequency in the 7-10 year and 16-20 year experience range (18.5 percent). This indicates that the civilians have more experience than the military respondents.

TABLE VII
RESPONSES BY EXPERIENCE

<u>Experience</u>	<u>Frequency</u>		<u>Percent</u>		<u>Cum %</u>	
	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>
0- 6 Years	28	9	41.8	13.8	41.8	13.8
7-10 Years	28	12	41.8	18.5	83.6	32.3
11-15 Years	8	9	11.9	13.8	95.5	46.2
16-20 Years	1	12	1.5	18.5	97.0	64.7
21-25 Years	0	10	0	15.4	97.0	80.1
26-30 Years	0	6	0	9.2	97.0	89.3
Over 30	0	6	0	9.2	97.0	98.5
Unspecified	2	1	3.0	1.5	100.0	100.0
TOTAL	67	65	100.0	100.0		

Table VIII shows that the majority of the civilian respondents to the survey had a Bachelor's degree (53.8 percent) and about a third had less than a Bachelor's degree (32.3 percent). It is not surprising that all the military had a Master's degree, since they were past graduates of the GEM program.

TABLE VIII
RESPONSES BY EDUCATION

<u>Education</u>	<u>Frequency</u>		<u>Percent</u>	
	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>
High School	0	7	0.0	10.8
Associate	0	14	0.0	21.5
Bachelor	0	35	0.0	53.8
Master	65	8	97.0	12.3
Doctorate	0	0	0.0	0.0
Unspecified	<u>2</u>	<u>1</u>	<u>3.0</u>	<u>1.5</u>
TOTAL	67	65	100.0	100.0

Table IX shows that most of the civilian respondents have undergraduate education in engineering (70.8 percent), rather than in management or other disciplines (12.4 percent). This confirms a recent study (A Profile of Plant Engineers & Facility Managers) published in 1987 by AIPE. Approximately 56 percent of the plant engineers possess a Bachelor's degree or greater, and of those who possess a Bachelor's degree, 70.5 percent have an engineering degree. This finding also supports the premise that private sector facility managers, who are responsible for the maintenance and repair of facilities, have backgrounds similar to the civil engineering officers. It was assumed that these private sector firms would draw upon personnel with a background similar to the civil engineering officer (Bachelor's degree in engineering), which is indeed the case shown here. Respondents (13.8 percent) who did not have an undergraduate education marked the not applicable response. Two respondents left this area blank.

TABLE IX

RESPONSES BY CIVILIAN UNDERGRADUATE EDUCATION

<u>Undergraduate Education</u>	<u>Frequency</u>	<u>Percent</u>
Engineering	46	70.8
Management	4	6.2
Other	4	6.2
Not Applicable	9	13.8
Unspecified	2	3.1
TOTAL	65	100.0

Table X shows that the majority of military and civilian responses are responsible for an annual operating budget of over \$1,000,000 (58.2 percent military, 60 percent civilian). The biggest disparity between the military and civilian samples is in the smallest budget range, from \$0-100,000. A quarter of the military sampled fell within this range, while only 6.2 percent for the civilians. A possible reason may be that base level jobs have responsibility over people instead of money.

TABLE X

RESPONSES BY BUDGET

<u>Budgets</u>	<u>Frequency</u>		<u>Percent</u>	
	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>
\$ 0-100K	17	4	25.4	6.2
\$100-500K	3	10	4.5	15.4
\$500K-1M	4	9	6.0	13.8
Over \$1M	39	39	58.2	60.0
Unspecified	4	3	6.0	4.6
TOTAL	67	65	100.0	100.0

Research Question #1

The 59 academic subjects that facility managers may perceive as important are divided into six broad categories as shown previously at Table III.

Research Question #2

Appendix G lists the mean responses to the three questions of (a) how much is applicable now, (b) how much should be applicable, and (c) the importance of the associated academic subject, as rated by the civilian and military respondents. By quick observation, it looks as if the mean ratings are close between the military and civilian responses for each question. This observation was suspect in some instances. Comments on three surveys said that there was not much differentiation between questions (a), (b), and (c), so these respondents generalized all three questions into one rating. A further investigation of the needs brings out this similarity in how the respondents answered the questions. The needs, which are discussed later in this section, showed only slight increases (less than one) in most academic subjects. This indicates that there were similar ratings of the (a) and (b) questions.

Table XI shows a pattern between the means of (a), (b), and (c). In each category the mean increases from (a) to (c). This suggests that there is an overall need for more application of academic subjects within all categories. The highest mean ratings of (a), (b), and (c) were on project

and qualitative categories, whereas the quantitative category received the lowest mean rating across the board. Financial, engineer/architect, and functional categories received average mean ratings. This result was not totally expected: the interviews suggested that the functional and qualitative categories would be rated higher than the other categories. While the qualitative category was rated important, the functional category was rated at only average importance.

TABLE XI
RESPONSES TO THE THREE QUESTIONS BY CATEGORY

<u>Categories</u>	(a)		(b)		(c)	
	How Much Do You Apply		How Much Should You		Importance	
	Civ Mean	Mil Mean	Civ Mean	Mil Mean	Civ Mean	Mil Mean
Quantitative	2.691	2.218	3.265	2.697	3.402	3.109
Qualitative	4.152	4.429	4.723	4.940	4.968	5.310
Financial	4.051	3.217	4.639	3.713	4.906	4.167
Project	4.585	4.560	5.177	4.776	5.362	5.091
Engineer/Arch	4.012	3.069	4.563	3.538	4.809	4.114
Functional	3.844	3.507	4.394	3.887	4.664	4.361

Table XII lists the needs for academic subjects which were rated important by the military respondents. See Appendix H for a complete listing of academic subjects. A positive need indicates there is not enough of the skill now being applied. The need is calculated by subtracting (b) from (a). When (b) is greater than (a), there is a positive need. All but one need was positive, meaning there are not enough of these academic subjects now being applied. The

needs are not very distinctive; all but three [energy management (2.345), information systems (1.086), and interior design (1.079)] are less than one.

The civilian respondents had one negative need (building fire protection) and three needs greater than one (mentioned previously). The military respondents did not have any negative needs or needs greater than one, showing a good balance between what academic subjects were applicable in their job and what should be applied. Of the academic skills which the military rated important, the highest needs are in information systems, management principles, organizational theory, and communication.

Table XII

IMPORTANCE & NEED RATINGS OF ACADEMIC SUBJECTS
(BY MILITARY RATING)

<u>Academic Subjects</u>	<u>Importance</u>		<u>Need</u>	
	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>
Professional Ethics	6.33	6.11	0.18	0.45
Public Speaking	6.18	5.27	0.44	0.60
Leadership	6.13	5.40	0.42	0.49
Management Principles	5.96	5.48	0.75	0.53
Personnel Management	5.86	5.83	0.47	0.49
Technical Writing	5.86	5.72	0.21	0.37
Communication	5.67	5.49	0.62	0.66
Construction Management	5.45	5.98	0.32	0.61
Behavioral Science	5.30	4.95	0.49	0.38
Project Management	5.28	5.84	0.13	0.58
Organizational Theory	5.23	4.81	0.52	0.79
Civil Engineering	5.22	4.06	0.27	0.48
Information Systems	5.08	4.25	0.83	1.08

Table XIII lists civilian and military needs by categories. The needs were higher in the qualitative and

financial categories for both military and civilian respondents. Even though the needs were shown to be greatest in these categories, the importance differs a little by showing the greatest ratings in the project and qualitative categories. The biggest disparity between the needs of the civilian and military was on the project category (0.391). The civilian respondents saw more need in the project area than did the military respondents, maybe because more problems exist in this area for the civilians than the military. Even though the project category is not rated highly by the military respondents, it does not imply it is not an important area. Rather, it only implies that the current amount of application is commensurate with how much should be applied.

TABLE XIII
NEED & IMPORTANCE BY CATEGORY

<u>Categories</u>	<u>Need</u>		<u>Importance</u>	
	<u>Civ</u> <u>Mean</u>	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>	<u>Mil</u> <u>Mean</u>
Quantitative	.574	.410	3.402	3.109
Qualitative	.601	.529	4.968	5.310
Financial	.622	.526	4.906	4.167
Project	.585	.194	5.362	5.091
Engineer/Arch	.549	.480	4.809	4.114
Functional	.568	.398	4.664	4.361

Research Question #3

Table XII lists the academic subjects that the military rated important. A complete listing of all academic subjects and their ratings is at appendix H. The academic

subjects which are seen as very important (a mean of 6+) are professional ethics, public speaking, and leadership. There were ten academic subjects (17 percent) rated as important (a mean of 5+), 17 academic subjects (29 percent) rated as average importance (a mean of 4+), 23 academic subjects (41 percent) rated as below average importance (a mean of 3+), five academic subjects (seven percent) rated as little importance (a mean of 2+), and one academic subject (two percent) rated as very little or of no importance (a mean of 1+).

The most important single academic subject was professional ethics: it was rated the most important academic subject by both the military (6.33) and civilian (6.109) respondents. There was also a consensus on the three least important academic subjects. They were queuing theory (Mil 2.84, Civ 2.839), linear programming (Mil 2.14, Civ 2.345), and simulation modeling (Mil 1.65, Civ 1.925). This result was reconfirmed by the AFIT GEM survey assessment. In it, operations research, statistical concepts, scientific research, and accounting concepts were rated low. Operations research includes queuing theory and linear programming, which were rated of little importance. However, statistical analysis was rated as important and cost accounting was rated of average importance; these results were not expected. The civilian respondents ranked more academic subjects between the important (36 percent)

and average (34 percent) range, while the military respondents ranked more academic subjects between the average (29 percent) and below average (41 percent) range.

Research Question #4

Appendix I lists the T-values and P-values from the t-test analyses which were used to check for differences in the importance means of academic subjects between the two samples.

The civilian respondents rated 20 academic subjects (34 percent) significantly higher than did the military; as shown in Table XIV.

TABLE XIV

ACADEMIC SUBJECTS RATED SIGNIFICANTLY HIGHER BY CIVILIANS

Energy Management	Safety Engineering
Mechanical Engineering	Installation and Space Management
Energy Efficient Designs	Building Fire Protection
Value Engineering	Electrical Engineering
Facility Operations	Maintenance Management
Inventory Planning	Managerial Accounting
Cost Accounting	Industrial Engineering
Budget Preparation	Contract Policy
Engineering Economy	Forecasting
Computer Room Design	Construction Management

Therefore, these academic subjects are considered more important to the civilian respondents than to the military respondents.

The military respondents rated four academic subjects (seven percent) significantly higher than did the civilians. These were information systems, leadership, public speaking,

and civil engineering. A reason information systems may be of more concern to the military is because of the Work Information Management System (WIMS) initiative. WIMS minicomputer systems are being installed at Air Force Civil Engineering Squadrons throughout the world. Leadership is so ingrained with being a military officer and officership, it is of little wonder that this academic subject is rated higher by the military than by their civilian counterparts. Also, in the military there are more opportunities to speak publicly than there may be in the civilian environment. Finally, a reason civil engineering may be rated higher by the military than the civilian is the military title of civil engineering officer.

There were 35 academic subjects (59 percent) without a significant difference in means between the military and civilian respondents. This indicated that the civilian and military respondents rated these academic subjects of approximately equal importance.

A rank order correlation was used as an overall assessment of how closely the military and civilian respondents ranked the academic subjects. A correlation of 0.72 was obtained, which showed that there was a high correlation between how the military and civilian respondents ranked academic subjects by importance.

V. Discussion and Conclusions

Introduction

The purpose of this research was to investigate educational requirements of both military and civilian facility managers. The compiled list of academic subjects considered important by facility managers may help guide the GEM program to better fit the demand of facility managers. This chapter summarizes the results and makes recommendations based on the findings of this research.

Demographics

Two populations were surveyed, civilians represented by recipients of the AIPE Facilities Management, Operations & Engineering magazine, and military officers, represented by past Air Force GEM students who graduated within the last five years. There were 67 officers and 65 civilians who responded to the survey. A census was conducted on the military, while a random sampling plan was applied to the civilian population. The civilian sample achieved the desired 90 percent confidence level, meaning that the sample statistics were representative of the original population.

Some of the demographics included the fact that over half of the respondents indicated that they had a background in engineering, were in the middle management position, and were responsible for budgets exceeding \$1,000,000. The predominant rank of the military responding to the survey

was captain. The majority of the civilians responding are employed by a manufacturing industry. The civilian respondents have more years of experience than do the military respondents, but have less formal education.

GEM Program

The present GEM program is 15 months in duration. Five quarters of classes and a short term are taught during that time. Appendix F lists the course titles taught and the credits associated with the class.

Previous Survey Results. Fiscal year 1985 GEM students rated operations research along with a couple of other quantitative courses low. The results of this survey reinforce the fiscal year 1985 GEM student rating by identifying two components of operations research as considered not very important to facility management (queuing theory and linear programming).

Improvement to Program. This survey lists some possible inclusions into the GEM program which may improve the overall program. Professional ethics was seen by both samples to be the most important academic subject in the survey. Also, 25 other academic subjects were rated important by the civilian or military respondents, and may have a potential for inclusion into existing GEM courses. Table XV lists the ratings and difference in means of the 26 academic subjects mentioned.

TABLE XV
ACADEMIC SUBJECTS RATED IMPORTANT
BY EITHER MILITARY OR CIVILIAN RESPONDENTS

<u>Academic Subjects</u>	Rating	
	Civ	Mil
Professional Ethics	6+	6+
*Facility Operations	6+	4+
*Leadership	5+	6+
*Construction Management	5+	5+
Management Principles	5+	5+
Technical Writing	5+	5+
Communication	5+	5+
Statistical Analysis	5+	5+
Strategic Planning	5+	5+
*Public Speaking	5+	5+
*Maintenance Management	5+	4+
*Contract Policy	5+	4+
*Bldg Fire Protection	5+	4+
Life Cycle Costing	5+	4+
*Budget Preparation	5+	4+
Building Programming	5+	4+
Organizational Theory	4+	5+
Behavioral Science	4+	5+
*Civil Engineering	4+	5+
*Information Systems	4+	5+
*Energy Management	5+	3+
*Mechanical Engineering	5+	3+
*Safety Engineering	5+	3+
*Energy Efficient Design	5+	3+
*Install & Space Mgt	5+	3+
*Electrical Engineering	5+	3+
*Value Engineering	5+	3+

* Academic subjects that were rated significantly different, as obtained from t-test results.

Very Little Or None	Little	Below Average	Average	Important	Very Important
-----	1+	2+	3+	4+	5+ 6+

Only one academic subject was rated very important by the military and civilian respondents (professional ethics). Eight academic subjects were rated important by the military and civilian respondents (construction management, management principles, leadership, technical writing, communication, statistical analysis, strategic planning, and public speaking). The military rated leadership and public speaking significantly higher than did the civilian respondents. The civilian respondents rated facility operations higher than did the military respondents. Six academic subjects were rated important by the civilian respondents and rated average importance by the military (maintenance management, contract policy, building fire protection, life cycle costing, budget preparation, and building programming). Of the six academic subjects, two had no significant difference between means (building programming and life cycle costing). The rest (maintenance management, contract policy, building fire protection, and budget preparation) had a significant difference between the means, with the civilian respondents rating these academic subjects higher than did the military respondents. Four academic subjects were rated important by the military respondents and average importance by the civilian respondents (organizational theory, behavioral science, civil engineering, and information systems). Of these four academic subjects, two (organizational theory and behavioral

science) had no significant differences between the means of the military and civilian respondents. The other two (civil engineering and information systems) were rated higher by the military respondents than the civilian respondents. Seven academic subjects were rated important by the civilian respondents and rated below average in importance by the military respondents (energy management, mechanical engineering, safety engineering, energy efficient design, installation and space management, electrical engineering, and value engineering). All seven academic subjects were rated significantly nigner by the civilian respondents than the military respondents.

Existing GEM Subjects. The academic subjects rated important by either the military or civilian respondents which the GEM program includes are:

Life Cycle Costing	Organizational Theory
Leadership	Management Principles
Contract Policy	Information Systems
Technical Writing	Energy Management
Communication	Strategic Planning
Statistical Analysis	Installation & Space Mgt
Public Speaking	Energy Efficient Designs

Potential GEM Inclusions. The academic subjects which are not included in the GEM program, but were rated important by either the civilian or military respondents:

Professional Ethics	Facility Operations
Construction Management	Building Fire Protection
Maintenance Management	Building Programming
Budget Preparation	Safety Engineering
Civil Engineering	Value Engineering
Mechanical Engineering	Electrical Engineering

Inclusion of these academic subjects may be achieved by allowing more electives into the GEM course.

Summary

In summary, a list of academic subjects was analyzed as to their importance in facilities management. The academic subjects were rated by military and private sector civilian facility managers. Ratings were given as to (a) how much is applicable now, (b) how much should be applicable, and (c) the importance. The need was determined by subtracting a from b ($b - a$). Differences in rating between the two populations were determined by t-tests and a rank order correlation.

The overall objective was to methodically and logically report and analyze academic subjects that may improve the GEM program. Professional ethics was seen by both populations to merit the most importance. Some of the popularity of this academic subject may stem from the recent publicity of Lt. Col. North and the Contra Arms Sales. Realizing the compressed 15-month scheduling of classes of the GEM program, it would be almost impossible to add courses into the already jammed course load. However, a shift of emphasis on some of the most important academic subjects included in Table XV may improve the scope of study.

Further research into this area is required. Only 59 academic subjects were addressed; many more may be of

potential interest. Also, only past GEM graduates were surveyed; more information may be gathered from civil engineering officers at base level. An area that was not addressed was how other government agencies educate their facility managers. It would have been interesting to include other services such as the Army and Navy engineers or facility engineers in charge of cities, colleges, or hospitals to see what their responses would have been.

Appendix A: Information Request Letter

20 January 1987

Gentlemen:

I am Captain David M. Kreag, an Air Force Institute of Technology student in Engineering Management at Wright Patterson AFB, Ohio. I am doing a thesis on how the private sector educates their facility managers (i.e., someone who is involved in overseeing the maintenance, repair, design, development, and construction of facilities) in comparison to how the Air Force conducts its program. The goal of my thesis is to improve the content of the Graduate Engineering Management program. What I want to focus on is subject matter: knowledge, subjects, and abilities that the facility engineer needs to do his/her job. I am also interested in certification qualifications or courses being taught either through colleges, universities, or by seminar. You can help me by providing a personal and/or a company list of subjects, course descriptions deemed important for facility managers, or anything else you think might be helpful. If you have any suggestions on publications to look at or people to contact to gain knowledge in this area, please let me know. I will appreciate any cooperation or suggestions you can give.

If you have anything you would like to share, please send it to the following address:

David M. Kreag
2361 Duncan Drive, Apt. #6
Fairborn, Ohio 45324

My phone number is (513) 429-4583; however with classes the best time to reach me is after 4 p.m. Thank you for your time.

Sincerely,

David M. Kreag

Appendix B: Organizations Contacted

Engineering Professional Development
University of Wisconsin
Madison, Wisconsin

TRW Operations & Support Group
Redondo Beach, California

California Polytechnic State University
San Luis Obispo, California

The Association of
Physical Plant Administrators of
Universities and Colleges
Alexandria, Virginia

XIT Grounding Systems
Torrance, California

Facilities Engineering
US Army Engineer School
Fort Belvoir, Virginia

American Society for Engineering Management
Lowell, Massachusetts

National Society of Professional Engineers
Alexandria, Virginia

University of Missouri
Department of Engineering Management
Rolla, Missouri

Bell Communications Research
Lisle, Illinois

American Institute of Plant Engineers
Cincinnati, Ohio

Appendix C: Survey Package for Civilian Sample



**American Institute of Plant Engineers
3975 Erie Ave. • Cincinnati, Ohio 45208 • (513) 561-6000**

27 April 1987

You have been selected at random to participate in a study on educational requirements for facility and plant engineers. It will take about 20-30 minutes of your time. Response is voluntary and private, but we would greatly appreciate your input.

The hypothesis is that there is a common core of educational skills that facility and plant engineers see as important. The American Institute of Plant Engineers in conjunction with the Air Force Institute of Technology is conducting this research to influence college programs to better fit the needs of industry.

Your response will be held in strict confidentiality. The questionnaire has an identification number for mailing purposes only. Your name will not be put on your questionnaire.

In order to help shape the education of future facility and plant engineers, it is important that each questionnaire be completed and returned by May 31, 1987. Thank you for your assistance.

Sincerely,

A handwritten signature in black ink that reads "Tom Klug".

Tom Klug
Director of Association Development

Education and Research Arm of the American Institute of Plant Engineers

SECTION I. NEED ASSESSMENT

On the following pages will be listed several educational subjects connected with your own management position. For each subject, you will be asked to give three ratings.

- a) How much of the subject are you able to apply in connection with your management position?
- b) How much of the subject do you think should be applicable in connection with your management position?
- c) How important is this subject to you?

Each rating will be on a seven-point scale.

(minimum) 1 2 3 4 5 6 7 (maximum)

Please completely fill in the circle (using a #2 pencil) that represents the amount of the subject being rated on the computer scan sheet enclosed with the survey form. Low numbers represent low or minimum amounts, and high numbers represent high or maximum amounts. If you think there is "very little" or "none" of the subject presently associated with the position, you would choose numeral 1. If you think there is "just a little," you would choose numeral 2, and so on. If you think there is a "great deal but not a maximum amount," you would choose numeral 6. If you think the subject does not apply to you, choose the circle with NA to the left of the corresponding question on the computer scan sheet.

For each subject, choose only one number.

Please do not omit any subjects.

QUANTITATIVE (minimum) 1 2 3 4 5 6 7 (maximum)

Linear Programming Concepts (Including Goal Programming, Integer Programming, & Sensitivity Analysis)

- 001) How much are you able to apply now?
- 002) How much should be applicable to your position?
- 003) How important is this to you?

Network Modeling (Including Program Evaluation Review Technique (PERT), and Critical Path Method (CPM))

- 004) How much are you able to apply now?
- 005) How much should be applicable to your position?
- 006) How important is this to you?

Simulation Modeling (Such as SLAM, SIMSCRIPT, etc.)

- 007) How much are you able to apply now?
- 008) How much should be applicable to your position?
- 009) How important is this to you?

Decision Theory (Including Risk & Uncertainty Analysis, Problem Solving Techniques, and Methods to Evaluate Alternatives)

- 010) How much are you able to apply now?
- 011) How much should be applicable to your position?
- 012) How important is this to you?

Forecasting (Including Seasonal Adjustments, Annual & Monthly Data Analysis, and Translating Market Factors into the Forecast)

- 013) How much are you able to apply now?
- 014) How much should be applicable to your position?
- 015) How important is this to you?

Queuing Theory (Such as System Modeling, Waiting Line Analysis, and Bottleneck Problems)

- 016) How much are you able to apply now?
- 017) How much should be applicable to your position?
- 018) How important is this to you?

Inventory Planning (Such as Economic Order Quantity Model, Material Requirements Planning Model, and Just-in-Time Inventory Control)

- 019) How much are you able to apply now?
- 020) How much should be applicable to your position?
- 021) How important is this to you?

Statistical Analysis (Including Probability Distributions, Hypothesis Testing, Interval Estimation, Analysis of Variance, and Regression & Correlation)

- 022) How much are you able to apply now?
- 023) How much should be applicable to your position?
- 024) How important is this to you?

QUALITATIVE (minimum) 1 2 3 4 5 6 7 (maximum)

General Management Principles (Such as Consideration of Manager's Types, Subjects, and Roles; and Methods to Increase Productivity Through Management)

- 025) How much are you able to apply now?
- 026) How much should be applicable to your position?
- 027) How important is this to you?

Organizational Theory (Including Organizational Designs, Control, Functions, and Socialization)

- 028) How much are you able to apply now?
- 029) How much should be applicable to your position?
- 030) How important is this to you?

Behavioral Science (Such as Industrial Psychology, Motivation Theory, etc.)

- 031) How much are you able to apply now?
- 032) How much should be applicable to your position?
- 033) How important is this to you?

Strategic Planning (Including Strategic Issues, Evaluating the Competitive Analyst's Report, Implementing Competitive Strategy, and Advertising Considerations)

- 034) How much are you able to apply now?
- 035) How much should be applicable to your position?
- 036) How important is this to you?

Leadership (Including Leadership Theories, Factors Influencing Leadership Effectiveness, and Cultural Differences in Leadership)

- 037) How much are you able to apply now?
- 038) How much should be applicable to your position?
- 039) How important is this to you?

Personnel Management (Including Performance Appraisal, Job Analysis, Training & Development, and Employee Selection)

- 040) How much are you able to apply now?
- 041) How much should be applicable to your position?
- 042) How important is this to you?

Master Planning (Including Planning Process, Sources & Organization of Planning Data, and Teamwork Concept to Prepare a Master Plan)

- 043) How much are you able to apply now?
044) How much should be applicable to your position?
045) How important is this to you?

FINANCIAL (minimum) 1 2 3 4 5 6 7 (maximum)

Managerial Accounting (Including Cost Concepts, Managerial Applications and Limitations of Cost Data in Planning & Control)

- 046) How much are you able to apply now?
047) How much should be applicable to your position?
048) How important is this to you?

Cost Accounting (Including Labor Cost Analysis, Distribution of Overhead, and Depreciation Methods)

- 049) How much are you able to apply now?
050) How much should be applicable to your position?
051) How important is this to you?

Engineering Economy (Including Capital Budgeting, Net Present Value Analysis, and Compound Interest Formulas)

- 052) How much are you able to apply now?
053) How much should be applicable to your position?
054) How important is this to you?

Financial Management (Including Financial Statements, Comparative Analysis, Cost/Volume Analysis, and Cash Flow & Working Capital Analysis)

- 055) How much are you able to apply now?
056) How much should be applicable to your position?
057) How important is this to you?

Budget Preparation (Including Budgeting for Capital Improvements, Financial Components & Concepts, and Budget Manager's Function)

- 058) How much are you able to apply now?
059) How much should be applicable to your position?
060) How important is this to you?

Building Programming (Including Building Planning Process, Site Evaluation, Total Space Requirements, and Total Building Energy & Control Systems)

- 061) How much are you able to apply now?
- 062) How much should be applicable to your position?
- 063) How important is this to you?

Life Cycle Costing (Including Economic Analysis, Reliability & Maintainability, Cost Estimating Techniques, and Procurement)

- 064) How much are you able to apply now?
- 065) How much should be applicable to your position?
- 066) How important is this to you?

PROJECT (minimum) 1 2 3 4 5 6 7 (maximum)

Project Management (Including Project Scheduling, Strategies for On-Time Project Completion, Developing Contingency Plans, Project Close-Out Activities)

- 067) How much are you able to apply now?
- 068) How much should be applicable to your position?
- 069) How important is this to you?

Group Projects (Group Dynamics & Interaction)

- 070) How much are you able to apply now?
- 071) How much should be applicable to your position?
- 072) How important is this to you?

ENGINEERING/ARCHITECTURE (minimum) 1 2 3 4 5 6 7 (maximum)

Civil Engineering

- 073) How much are you able to apply now?
- 074) How much should be applicable to your position?
- 075) How important is this to you?

Mechanical Engineering

- 076) How much are you able to apply now?
- 077) How much should be applicable to your position?
- 078) How important is this to you?

Electrical Engineering

- 079) How much are you able to apply now?
- 080) How much should be applicable to your position?
- 081) How important is this to you?

Industrial Engineering (Including Quality Control Techniques, Productivity Measurements, and Time and Motion Studies)

- 082) How much are you able to apply now?
- 083) How much should be applicable to your position?
- 084) How important is this to you?

Architectural Design

- 085) How much are you able to apply now?
- 086) How much should be applicable to your position?
- 087) How important is this to you?

Interior Design (Including Mechanical Considerations, Electrical Considerations, and Interior Construction)

- 088) How much are you able to apply now?
- 089) How much should be applicable to your position?
- 090) How important is this to you?

Computer Systems Design (Including Computer Design, System Hardware & Software, and System Control)

- 091) How much are you able to apply now?
- 092) How much should be applicable to your position?
- 093) How important is this to you?

Safety Engineering (Including OSHA Requirements, Evaluating Alternative Safety Features, and Implementation of Safety Features in Design & Existing Equipment)

- 094) How much are you able to apply now?
- 095) How much should be applicable to your position?
- 096) How important is this to you?

Value Engineering (Including Negotiating, Servicing, Approving, Administering, and Evaluating the Contractual Value Engineering Effort of Contractors)

- 097) How much are you able to apply now?
- 098) How much should be applicable to your position?
- 099) How important is this to you?

Energy Efficient Designs (Including Evaluation Techniques of Energy Efficient Designs)

- 100) How much are you able to apply now?
- 101) How much should be applicable to your position?
- 102) How important is this to you?

FUNCTIONAL (minimum) 1 2 3 4 5 6 7 (maximum)

Computer Science (Including Historical Development, Parts of a Computer, Functions of a Computer and Computer Programming)

- 103) How much are you able to apply now?
- 104) How much should be applicable to your position?
- 105) How important is this to you?

Information Systems (Including Management Information System, and Decision Support System)

- 106) How much are you able to apply now?
- 107) How much should be applicable to your position?
- 108) How important is this to you?

Computer Aided Design / Computer Aided Manufacturing

- 109) How much are you able to apply now?
- 110) How much should be applicable to your position?
- 111) How important is this to you?

Computer Room Design (Including Flooring, Air Conditioning, Equipment Selection, Grounding, and Line Conditioning)

- 112) How much are you able to apply now?
- 113) How much should be applicable to your position?
- 114) How important is this to you?

Communication (Including Interviewing Techniques, Panel Discussions, Meeting Management, and Conflict Resolution)

- 115) How much are you able to apply now?
- 116) How much should be applicable to your position?
- 117) How important is this to you?

Public Speaking (Including Delivery Techniques, Audio/Visual Use, and Handling the Questions and Answers)

- 118) How much are you able to apply now?
- 119) How much should be applicable to your position?
- 120) How important is this to you?

Technical Writing (Including Grammar, Syntax, Mechanics, and Style & Format)

- 121) How much are you able to apply now?
- 122) How much should be applicable to your position?
- 123) How important is this to you?

Business Law (Such as Crimes, Torts, Frauds, Employment Law, and Partnerships & Corporations)

- 124) How much are you able to apply now?
- 125) How much should be applicable to your position?
- 126) How important is this to you?

Marketing (Including Preliminary Analysis, Listening to Customers, Marketing Philosophy & Strategy, and Advertising & Promotion)

- 127) How much are you able to apply now?
- 128) How much should be applicable to your position?
- 129) How important is this to you?

Quality Control (Such as Statistical Quality Control, Quality Assurance, and Material Handling)

- 130) How much are you able to apply now?
- 131) How much should be applicable to your position?
- 132) How important is this to you?

Research & Design Management (Such as Management Techniques in a Research & Design Environment, and Scheduling Techniques)

- 133) How much are you able to apply now?
- 134) How much should be applicable to your position?
- 135) How important is this to you?

Innovation Techniques (Such as Brain Storming, Nominal Group Technique, and the Delphi Method)

- 136) How much are you able to apply now?
- 137) How much should be applicable to your position?
- 138) How important is this to you?

Entrepreneurship (Including Market Evaluation, Business Law, Evaluating Alternatives, and Franchising)

- 139) How much are you able to apply now?
- 140) How much should be applicable to your position?
- 141) How important is this to you?

Professional Ethics

- 142) How much are you able to apply now?
- 143) How much should be applicable to your position?
- 144) How important is this to you?

Labor Relations (Such as Landmark Judicial Decisions, Current Trends, and Formalized Labor Relations)

- 145) How much are you able to apply now?
- 146) How much should be applicable to your position?
- 147) How important is this to you?

Collective Bargaining (Including Grievance Situations and Dispute Settlements)

- 148) How much are you able to apply now?
- 149) How much should be applicable to your position?
- 150) How important is this to you?

Public Policy (Including How Government Policy Affects the General Movement of the Economy)

- 151) How much are you able to apply now?
- 152) How much should be applicable to your position?
- 153) How important is this to you?

Contract Policy (Including the Bid Process; Contract Discrepancies; Specification Writing; and Responsibilities of the Owner, Architect, and Contractor)

- 154) How much are you able to apply now?
- 155) How much should be applicable to your position?
- 156) How important is this to you?

Building Fire Protection (Including Fire Prevention, Protection, and Safety Administration)

- 157) How much are you able to apply now?
- 158) How much should be applicable to your position?
- 159) How important is this to you?

Real Estate Acquisition & Disposal (Including Appraisal Analysis, and Real Estate Laws)

- 160) How much are you able to apply now?
- 161) How much should be applicable to your position?
- 162) How important is this to you?

Installation & Space Management (Including Plant Layout and Design, and System Flow Analysis)

- 163) How much are you able to apply now?
- 164) How much should be applicable to your position?
- 165) How important is this to you?

Construction Management (Including Building Inspections, and Interpretation and Use of Drawings & Specifications)

- 166) How much are you able to apply now?
- 167) How much should be applicable to your position?
- 168) How important is this to you?

Maintenance Management (Including Preventative Maintenance Schedules, and Evaluating Techniques)

- 169) How much are you able to apply now?
- 170) How much should be applicable to your position?
- 171) How important is this to you?

Facility Operations (Including Design Parameters, Building Maintenance, Preventative Maintenance, and Fire & Safety Considerations)

- 172) How much are you able to apply now?
- 173) How much should be applicable to your position?
- 174) How important is this to you?

Energy Management (Including Energy Conservation Techniques, and Evaluating Alternatives)

- 175) How much are you able to apply now?
- 176) How much should be applicable to your position?
- 177) How important is this to you?

SECTION II. DEMOGRAPHICS

178. My position level is _____.

- 1) Upper Management
- 2) Middle Management
- 3) First Level Manager/Supervisor
- 4) Engineer
- 5) Other _____ (Please specify.)

179. The company I work for does _____.

- 1) Manufacturing
- 2) Non-Manufacturing

180. My years of experience in facility maintenance and plant engineering is _____.

- 1) 0- 6 years
- 2) 7-10 years
- 3) 11-15 years
- 4) 16-20 years
- 5) 21-25 years
- 6) 26-30 years
- 7) Over 30

181. My highest level of formal education achieved is

- 1) High School Diploma or Equivalent
- 2) Associate's Degree
- 3) Bachelor's Degree
- 4) Master's Degree
- 5) Doctorate

182. My undergraduate education is in _____.

- 1) Engineering/Technology
- 2) Management
- 3) Other _____ (Please specify.)
- 4) Not Applicable (No Bachelor's Degree)

183. The annual operating budget for which I am responsible is \$ _____.

- 1) \$ 0 - 100,000
- 2) \$ 100,001 - 500,000
- 3) \$ 500,001 - 1,000,000
- 4) \$ 1,000,001 - 5,000,000
- 5) \$ 5,000,001 - 10,000,000
- 6) \$ 10,000,001 - 15,000,000
- 7) \$ over 15,000,000

Appendix D: Survey Package for Military Sample

LS (Capt Kreag, AUTOVON 785-5435)

Educational Need Assessment Survey Package

1. Please take the time to complete the attached questionnaire and return it to us in the enclosed envelope by 15 June 1987.
2. The survey measures your perceptions and attitudes toward academic subjects that contribute to your job. The data we gather will become part of the Air Force Institute of Technology research project and may influence the courses taught in the Graduate Engineering Management program. Your individual responses will be combined with others and will not be attributed to you personally.
3. Your participation is completely voluntary, but we would certainly appreciate your help. For further information, contact Maj. Hal Rumsey at AUTOVON 785-5023.

HAL A. RUMSEY, Maj, USAF
GEM Program Director

2 Atch
1. Questionnaire
2. Return Envelope

SECTION I. NEED ASSESSMENT

On the following pages will be listed several educational subjects connected with your own management position. For each subject, you will be asked to give three ratings.

- a) How much of the subject are you able to apply in connection with your management position?
- b) How much of the subject do you think should be applicable in connection with your management position?
- c) How important is this subject to you?

Each rating will be on a seven-point scale.

(minimum) 1 2 3 4 5 6 7 (maximum)

Please completely fill in the circle (using a #2 pencil) that represents the amount of the subject being rated on the computer scan sheet enclosed with the survey form. Low numbers represent low or minimum amounts, and high numbers represent high or maximum amounts. If you think there is "very little" or "none" of the subject presently associated with the position, you would choose numeral 1. If you think there is "just a little," you would choose numeral 2, and so on. If you think there is a "great deal but not a maximum amount," you would choose numeral 6. If you think the subject does not apply to you, choose the circle with NA to the left of the corresponding question on the computer scan sheet.

For each subject, choose only one number.

Please do not omit any subjects.

QUANTITATIVE (minimum) 1 2 3 4 5 6 7 (maximum)

Linear Programming Concepts (Including Goal Programming, Integer Programming, & Sensitivity Analysis)

- 001) How much are you able to apply now?
- 002) How much should be applicable to your position?
- 003) How important is this to you?

Network Modeling (Including Program Evaluation Review Technique (PERT), and Critical Path Method (CPM))

- 004) How much are you able to apply now?
- 005) How much should be applicable to your position?
- 006) How important is this to you?

Simulation Modeling (Such as SLAM, SIMSCRIPT, etc.)

- 007) How much are you able to apply now?
- 008) How much should be applicable to your position?
- 009) How important is this to you?

Decision Theory (Including Risk & Uncertainty Analysis, Problem Solving Techniques, and Methods to Evaluate Alternatives)

- 010) How much are you able to apply now?
- 011) How much should be applicable to your position?
- 012) How important is this to you?

Forecasting (Including Seasonal Adjustments, Annual & Monthly Data Analysis, and Translating Market Factors into the Forecast)

- 013) How much are you able to apply now?
- 014) How much should be applicable to your position?
- 015) How important is this to you?

Queueing Theory (Such as System Modeling, Waiting Line Analysis, and Bottleneck Problems)

- 016) How much are you able to apply now?
- 017) How much should be applicable to your position?
- 018) How important is this to you?

Inventory Planning (Such as Economic Order Quantity Model, Material Requirements Planning Model, and Just-in-Time Inventory Control)

- 019) How much are you able to apply now?
- 020) How much should be applicable to your position?
- 021) How important is this to you?

Statistical Analysis (Including Probability Distributions, Hypothesis Testing, Interval Estimation, Analysis of Variance, and Regression & Correlation)

- 022) How much are you able to apply now?
- 023) How much should be applicable to your position?
- 024) How important is this to you?

QUALITATIVE (minimum) 1 2 3 4 5 6 7 (maximum)

General Management Principles (Such as Consideration of Manager's Types, Subjects, and Roles; and Methods to Increase Productivity Through Management)

- 025) How much are you able to apply now?
- 026) How much should be applicable to your position?
- 027) How important is this to you?

Organizational Theory (Including Organizational Designs, Control, Functions, and Socialization)

- 028) How much are you able to apply now?
- 029) How much should be applicable to your position?
- 030) How important is this to you?

Behavioral Science (Such as Industrial Psychology, Motivation Theory, etc.)

- 031) How much are you able to apply now?
- 032) How much should be applicable to your position?
- 033) How important is this to you?

Strategic Planning (Including Strategic Issues, Evaluating the Competitive Analyst's Report, Implementing Competitive Strategy, and Advertising Considerations)

- 034) How much are you able to apply now?
- 035) How much should be applicable to your position?
- 036) How important is this to you?

Leadership (Including Leadership Theories, Factors Influencing Leadership Effectiveness, and Cultural Differences in Leadership)

- 037) How much are you able to apply now?
- 038) How much should be applicable to your position?
- 039) How important is this to you?

Personnel Management (Including Performance Appraisal, Job Analysis, Training & Development, and Employee Selection)

- 040) How much are you able to apply now?
- 041) How much should be applicable to your position?
- 042) How important is this to you?

Master Planning (Including Planning Process, Sources & Organization of Planning Data, and Teamwork Concept to Prepare a Master Plan)

- 043) How much are you able to apply now?
044) How much should be applicable to your position?
045) How important is this to you?

FINANCIAL (minimum) 1 2 3 4 5 6 7 (maximum)

Managerial Accounting (Including Cost Concepts, Managerial Applications and Limitations of Cost Data in Planning & Control)

- 046) How much are you able to apply now?
047) How much should be applicable to your position?
048) How important is this to you?

Cost Accounting (Including Labor Cost Analysis, Distribution of Overhead, and Depreciation Methods)

- 049) How much are you able to apply now?
050) How much should be applicable to your position?
051) How important is this to you?

Engineering Economy (Including Capital Budgeting, Net Present Value Analysis, and Compound Interest Formulas)

- 052) How much are you able to apply now?
053) How much should be applicable to your position?
054) How important is this to you?

Financial Management (Including Financial Statements, Comparative Analysis, Cost/Volume Analysis, and Cash Flow & Working Capital Analysis)

- 055) How much are you able to apply now?
056) How much should be applicable to your position?
057) How important is this to you?

Budget Preparation (Including Budgeting for Capital Improvements, Financial Components & Concepts, and Budget Manager's Function)

- 058) How much are you able to apply now?
059) How much should be applicable to your position?
060) How important is this to you?

Building Programming (Including Building Planning Process, Site Evaluation, Total Space Requirements, and Total Building Energy & Control Systems)

- 061) How much are you able to apply now?
062) How much should be applicable to your position?
063) How important is this to you?

Life Cycle Costing (Including Economic Analysis, Reliability & Maintainability, Cost Estimating Techniques, and Procurement)

- 064) How much are you able to apply now?
065) How much should be applicable to your position?
066) How important is this to you?

PROJECT (minimum) 1 2 3 4 5 6 7 (maximum)

Project Management (Including Project Scheduling, Strategies for On-Time Project Completion, Developing Contingency Plans, Project Close-Out Activities)

- 067) How much are you able to apply now?
068) How much should be applicable to your position?
069) How important is this to you?

Group Projects (Group Dynamics & Interaction)

- 070) How much are you able to apply now?
071) How much should be applicable to your position?
072) How important is this to you?

ENGINEERING/ARCHITECTURE minimum) 1 2 3 4 5 6 7 (maximum)

Civil Engineering

- 073) How much are you able to apply now?
074) How much should be applicable to your position?
075) How important is this to you?

Mechanical Engineering

- 076) How much are you able to apply now?
077) How much should be applicable to your position?
078) How important is this to you?

Electrical Engineering

- 079) How much are you able to apply now?
080) How much should be applicable to your position?
081) How important is this to you?

Industrial Engineering (Including Quality Control Techniques, Productivity Measurements, and Time and Motion Studies)

- 082) How much are you able to apply now?
- 083) How much should be applicable to your position?
- 084) How important is this to you?

Architectural Design

- 085) How much are you able to apply now?
- 086) How much should be applicable to your position?
- 087) How important is this to you?

Interior Design (Including Mechanical Considerations, Electrical Considerations, and Interior Construction)

- 088) How much are you able to apply now?
- 089) How much should be applicable to your position?
- 090) How important is this to you?

Computer Systems Design (Including Computer Design, System Hardware & Software, and System Control)

- 091) How much are you able to apply now?
- 092) How much should be applicable to your position?
- 093) How important is this to you?

Safety Engineering (Including OSHA Requirements, Evaluating Alternative Safety Features, and Implementation of Safety Features in Design & Existing Equipment)

- 094) How much are you able to apply now?
- 095) How much should be applicable to your position?
- 096) How important is this to you?

Value Engineering (Including Negotiating, Servicing, Approving, Administering, and Evaluating the Contractual Value Engineering Effort of Contractors)

- 097) How much are you able to apply now?
- 098) How much should be applicable to your position?
- 099) How important is this to you?

Energy Efficient Designs (Including Evaluation Techniques of Energy Efficient Designs)

- 100) How much are you able to apply now?
- 101) How much should be applicable to your position?
- 102) How important is this to you?

FUNCTIONAL (minimum) 1 2 3 4 5 6 7 (maximum)

Computer Science (Including Historical Development, Parts of a Computer, Functions of a Computer and Computer Programming)

- 103) How much are you able to apply now?
104) How much should be applicable to your position?
105) How important is this to you?

Information Systems (Including Management Information System, and Decision Support System)

- 106) How much are you able to apply now?
107) How much should be applicable to your position?
108) How important is this to you?

Computer Aided Design / Computer Aided Manufacturing

- 109) How much are you able to apply now?
110) How much should be applicable to your position?
111) How important is this to you?

Computer Room Design (Including Flooring, Air Conditioning, Equipment Selection, Grounding, and Line Conditioning)

- 112) How much are you able to apply now?
113) How much should be applicable to your position?
114) How important is this to you?

Communication (Including Interviewing Techniques, Panel Discussions, Meeting Management, and Conflict Resolution)

- 115) How much are you able to apply now?
116) How much should be applicable to your position?
117) How important is this to you?

Public Speaking (Including Delivery Techniques, Audio/Visual Use, and Handling the Questions and Answers)

- 118) How much are you able to apply now?
119) How much should be applicable to your position?
120) How important is this to you?

Technical Writing (Including Grammar, Syntax, Mechanics, and Style & Format)

- 121) How much are you able to apply now?
122) How much should be applicable to your position?
123) How important is this to you?

Business Law (Such as Crimes, Torts, Frauds, Employment Law, and Partnerships & Corporations)

- 124) How much are you able to apply now?
- 125) How much should be applicable to your position?
- 126) How important is this to you?

Marketing (Including Preliminary Analysis, Listening to Customers, Marketing Philosophy & Strategy, and Advertising & Promotion)

- 127) How much are you able to apply now?
- 128) How much should be applicable to your position?
- 129) How important is this to you?

Quality Control (Such as Statistical Quality Control, Quality Assurance, and Material Handling)

- 130) How much are you able to apply now?
- 131) How much should be applicable to your position?
- 132) How important is this to you?

Research & Design Management (Such as Management Techniques in a Research & Design Environment, and Scheduling Techniques)

- 133) How much are you able to apply now?
- 134) How much should be applicable to your position?
- 135) How important is this to you?

Innovation Techniques (Such as Brain Storming, Nominal Group Technique, and the Delphi Method)

- 136) How much are you able to apply now?
- 137) How much should be applicable to your position?
- 138) How important is this to you?

Entrepreneurship (Including Market Evaluation, Business Law, Evaluating Alternatives, and Franchising)

- 139) How much are you able to apply now?
- 140) How much should be applicable to your position?
- 141) How important is this to you?

Professional Ethics

- 142) How much are you able to apply now?
- 143) How much should be applicable to your position?
- 144) How important is this to you?

Labor Relations (Such as Landmark Judicial Decisions, Current Trends, and Formalized Labor Relations)

- 145) How much are you able to apply now?
- 146) How much should be applicable to your position?
- 147) How important is this to you?

Collective Bargaining (Including Grievance Situations and Dispute Settlements)

- 148) How much are you able to apply now?
- 149) How much should be applicable to your position?
- 150) How important is this to you?

Public Policy (Including How Government Policy Affects the General Movement of the Economy)

- 151) How much are you able to apply now?
- 152) How much should be applicable to your position?
- 153) How important is this to you?

Contract Policy (Including the Bid Process; Contract Discrepancies; Specification Writing; and Responsibilities of the Owner, Architect, and Contractor)

- 154) How much are you able to apply now?
- 155) How much should be applicable to your position?
- 156) How important is this to you?

Building Fire Protection (Including Fire Prevention, Protection, and Safety Administration)

- 157) How much are you able to apply now?
- 158) How much should be applicable to your position?
- 159) How important is this to you?

Real Estate Acquisition & Disposal (Including Appraisal Analysis, and Real Estate Laws)

- 160) How much are you able to apply now?
- 161) How much should be applicable to your position?
- 162) How important is this to you?

Installation & Space Management (Including Plant Layout and Design, and System Flow Analysis)

- 163) How much are you able to apply now?
- 164) How much should be applicable to your position?
- 165) How important is this to you?

Construction Management (Including Building Inspections, and Interpretation and Use of Drawings & Specifications)

- 166) How much are you able to apply now?
- 167) How much should be applicable to your position?
- 168) How important is this to you?

Maintenance Management (Including Preventative Maintenance Schedules, and Evaluating Techniques)

- 169) How much are you able to apply now?
- 170) How much should be applicable to your position?
- 171) How important is this to you?

Facility Operations (Including Design Parameters, Building Maintenance, Preventative Maintenance, and Fire & Safety Considerations)

- 172) How much are you able to apply now?
- 173) How much should be applicable to your position?
- 174) How important is this to you?

Energy Management (Including Energy Conservation Techniques, and Evaluating Alternatives)

- 175) How much are you able to apply now?
- 176) How much should be applicable to your position?
- 177) How important is this to you?

SECTION II. DEMOGRAPHICS

178. My position level is _____.

- 1) Upper Management
- 2) Middle Management
- 3) First Level Manager/Supervisor
- 4) Engineer
- 5) Other _____ (Please specify.)

179. My rank is _____.

- 1) Lieutenant
- 2) Captain
- 3) Major
- 4) Lt Colonel

180. My years of experience in civil engineering is
_____.

- 1) 0- 6 years
- 2) 7-10 years
- 3) 11-15 years
- 4) 16-20 years
- 5) 21-25 years
- 6) 26-30 years
- 7) Over 30

181. My highest level of formal education achieved is
_____.

- 1) Bachelor's Degree
- 2) Master's Degree
- 3) Doctorate

182. The annual operating budget for which I am responsible
is \$ _____.

- 1) \$ 0 - 1,000
- 2) \$ 1,001 - 10,000
- 3) \$ 10,001 - 100,000
- 4) \$ 100,001 - 500,000
- 5) \$ 500,001 - 1,000,000
- 6) \$ over 1,000,000

Appendix E: AFIT Data Collection Form

AFIT DATA COLLECTION FORM

001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025
026	027	028	029	030	031	032	033	034	035	036	037	038	039	040	041	042	043	044	045	046	047	048	049	050
051	052	053	054	055	056	057	058	059	060	061	062	063	064	065	066	067	068	069	070	071	072	073	074	075
076	077	078	079	080	081	082	083	084	085	086	087	088	089	090	091	092	093	094	095	096	097	098	099	100
091	092	093	094	095	096	097	098	099	100	001	002	003	004	005	006	007	008	009	000	001	002	003	004	005

AFIT 11E



Digitized by srujanika@gmail.com

Appendix E (Continued)

Appendix F: GEM Course Titles

<u>GEM Course Titles</u>	<u>Credit Hours</u>
Elements of Financial and Managerial Accounting	2*
Introduction to AFIT Computer Systems	2*
Math Review for Engineers	2*
Research Orientation	0
Managerial Statistics	3
Theory and Practice of Professional Communication	3
Computer Programming	3
Organization and Management	3
Executive Engineering Management Symposia	0
Environmental & Energy Issues	4
Research Methods	2
Organizational Behavior	3
Managerial Statistics II	3
Independent Study	1
Executive Engineering Management Symposia	0
Engineering Management Information	3
Introduction. to Management Science	4
Elective	3
Independent Study	2
Executive Engineering Management Symposia	0
Contracting for Engineers	3
Engineering Management Techniques	4
Federal Financial Management	3
Elective	3
Independent Study	1
Executive Engineering Management Symposia	0
Independent Study	2
Seminar in Engineering Management	3
Elective	3
Executive Engineering Management Symposia	1
Independent Study	6
TOTAL CREDIT HOURS	72
Undergraduate Credit Hours	<u>-6</u>
Graduate Credit Hours	66

* Indicates Undergraduate Credit

**Appendix G: Responses to the Three Questions
(By Military Rating)**

<u>Academic Subject</u>	How Much Do You Apply		How Much Should You		Importance	
	Civ Mean	Mil Mean	Civ Mean	Mil Mean	Civ Mean	Mil Mean
Professional Ethics	5.36	5.74	5.80	5.92	6.11	6.33
Public Speaking	4.38	5.41	5.03	5.85	5.27	5.18
Leadership	4.57	5.40	5.09	5.73	5.40	6.13
Management Prin	4.72	4.91	5.26	5.66	5.48	5.96
Technical Writing	4.79	5.58	5.39	5.79	5.72	5.86
Personnel Mgt	4.92	4.72	5.36	5.20	5.83	5.80
Communication	4.65	4.91	5.22	5.59	5.49	5.67
Construction Mgt	5.08	4.14	5.48	4.46	5.98	5.45
Behavioral Sci	4.31	4.44	4.64	4.95	4.95	5.30
Project Mgt	4.94	4.81	5.57	4.94	5.84	5.28
Organizational Beh	4.02	4.33	4.79	4.85	4.81	5.23
Civil Engrg	3.38	3.98	3.78	4.25	4.06	5.22
Information Sys	3.32	3.97	4.02	4.80	4.25	5.08
Contract Policy	4.89	4.03	5.52	4.46	5.77	4.98
Group Projects	4.17	4.42	4.75	4.70	4.84	4.96
Master Planning	4.02	4.03	4.66	4.73	4.81	4.95
Building Pgm	4.57	3.83	5.23	4.38	5.45	4.90
Facility Oper	5.22	3.71	5.81	4.02	6.05	4.83
Budget Prep	5.00	3.73	5.39	4.40	5.58	4.81
Maintenance Mgt	5.08	3.31	5.69	3.74	5.95	4.70
Innovation Tech	3.51	3.96	4.23	4.41	4.44	4.54
Life Cycle Cost	3.86	3.25	4.77	3.91	5.03	4.51
Computer Systems	2.81	3.39	3.89	4.15	4.16	4.49
Interior Design	3.93	3.11	4.44	3.74	4.67	4.41
Building Fire Prot	5.02	3.36	5.39	3.91	5.66	4.31
Arch Designs	3.68	3.09	3.90	3.59	4.00	4.30
Labor Relations	3.22	3.11	3.67	3.55	4.20	4.27
Computer Science	2.73	3.45	3.60	3.89	3.86	4.20
Decision Theory	3.32	3.40	4.03	4.09	4.05	4.14
Engineering Econ	4.19	3.03	4.65	3.32	4.92	4.09
Managerial Acct	3.97	3.09	4.64	3.71	4.89	3.95
Energy Mgt	4.77	2.95	5.46	3.33	5.75	3.94
Mechanical Engrg	4.95	2.81	5.43	3.33	5.54	3.93
Energy Eff Designs	4.40	2.87	4.95	3.27	5.35	3.92
Collective Barg	3.44	2.61	4.09	3.00	4.57	3.90
Electrical Engrg	4.41	2.67	5.00	3.32	5.20	3.88
Value Engrg	4.44	3.00	4.83	3.46	5.16	3.83
Safety Engrg	4.63	3.10	5.20	3.63	5.52	3.81
Public Policy	2.51	2.91	3.02	3.24	3.40	3.76
Quality Control	3.71	2.79	4.16	3.15	4.31	3.70
Installation &	4.19	2.70	5.03	3.05	5.28	3.66
Business Law	3.12	2.85	3.48	3.28	3.66	3.65
Financial Mgt	3.34	2.94	3.60	3.21	4.00	3.63

Appendix G (Continued)

<u>Academic Subject</u>	How Much Do You Apply		How Much Should You		Importance	
	Civ Mean	Mil Mean	Civ Mean	Mil Mean	Civ Mean	Mil Mean
CAD / CAM	2.67	2.07	3.78	2.81	3.83	3.62
Strategic Plan	2.67	2.98	3.27	3.36	3.40	3.62
Network Modeling	3.07	2.70	3.77	3.31	3.63	3.57
Cost Accounting	3.74	2.85	4.29	3.28	4.46	3.50
Computer Room Des	3.29	2.52	4.09	3.00	4.23	3.45
R & D Management	2.83	2.64	3.32	2.88	3.43	3.44
Marketing	2.69	2.69	2.98	2.97	3.11	3.39
Industrial Engrg	3.54	2.41	4.08	2.84	4.21	3.35
Statistical Anal	2.64	2.38	2.74	2.75	2.90	3.23
Forecasting	3.18	2.32	3.71	2.90	3.88	3.08
Real Estate Acq	2.76	2.18	2.71	2.61	3.11	2.97
Entrepreneurship	2.40	2.44	2.56	2.52	2.93	2.88
Inventory Plan	3.27	2.05	3.95	2.15	4.02	2.86
Queuing Theory	2.53	2.10	2.70	2.51	2.84	2.84
Linear Program	1.90	1.71	2.68	2.26	2.35	2.14
Simulation Modeling	1.48	1.15	1.94	1.46	1.93	1.65

**Appendix H: Importance & Need Ratings of Academic Subjects
(By Military Rating)**

<u>Academic Subjects</u>	Importance		Need	
	Mil Mean	Civ Mean	Mil Mean	Civ Mean
Professional Ethics	6.33	6.11	0.18	0.45
Public Speaking	6.18	5.27	0.44	0.60
Leadership	6.13	5.40	0.42	0.49
Management Principles	5.96	5.48	0.75	0.58
Personnel Management	5.86	5.83	0.47	0.49
Technical Writing	5.86	5.72	0.21	0.37
Communication	5.67	5.49	0.62	0.66
Construction Management	5.45	5.98	0.32	0.61
Behavioral Science	5.30	4.95	0.49	0.38
Project Management	5.28	5.84	0.13	0.58
Organizational Theory	5.23	4.81	0.52	0.79
Civil Engineering	5.22	4.06	0.27	0.48
Information Systems	5.08	4.25	0.83	1.08
Contract Policy	4.98	5.77	0.43	0.38
Group Projects	4.96	4.84	0.26	0.40
Master Planning	4.95	4.81	0.68	0.69
Building Programming	4.90	5.45	0.55	0.65
Facility Operations	4.83	6.05	0.30	0.69
Budget Preparation	4.81	5.58	0.67	0.37
Maintenance Management	4.70	5.95	0.39	0.60
Innovation Techniques	4.54	4.44	0.47	0.17
Life Cycle Costing	4.51	5.03	0.63	0.86
Computer Systems Design	4.49	4.16	0.85	0.56
Interior Design	4.41	4.67	0.63	1.08
Building Fire Protection	4.31	5.66	0.51	-.02
Architectural Design	4.30	4.00	0.50	0.49
Labor Relations	4.27	4.20	0.48	0.69
Computer Science	4.20	3.86	0.44	0.68
Decision Theory	4.14	4.05	0.69	0.71
Engineering Economics	4.09	4.92	0.30	0.45
Managerial Accounting	3.95	4.89	0.62	0.67
Energy Management	3.94	5.75	0.38	2.35
Mechanical Engineering	3.93	5.54	0.52	0.59
Energy Efficient Designs	3.92	5.35	0.41	0.87
Collective Bargaining	3.90	4.57	0.39	0.45
Electrical Engineering	3.88	5.20	0.65	0.54
Value Engineering	3.83	5.16	0.47	0.55
Safety Engineering	3.81	5.52	0.53	0.40
Public Policy	3.76	3.40	0.33	0.63
Quality Control	3.70	4.31	0.36	0.44
Installation & Space Mgt	3.66	5.28	0.35	0.40

Appendix H (Continued)

<u>Academic Subjects</u>	Importance		Need	
	Mil Mean	Civ Mean	Mil Mean	Civ Mean
Business Law	3.65	3.66	0.43	0.31
Financial Management	3.63	4.00	0.27	0.25
CAD / CAM	3.62	3.83	0.74	0.80
Strategic Planning	3.62	3.40	0.37	0.63
Network Modeling	3.57	3.63	0.60	0.80
Cost Accounting	3.50	4.46	0.43	0.56
Computer Room Design	3.45	4.23	0.48	0.57
R & D Management	3.44	3.43	0.24	0.72
Marketing	3.39	3.11	0.25	0.40
Industrial Engineering	3.35	4.21	0.43	0.22
Statistical Analysis	3.23	2.90	0.42	0.14
Forecasting	3.08	3.88	0.59	0.53
Real Estate Acq & Disp	2.97	3.11	0.43	0.84
Entrepreneur	2.88	2.93	0.05	0.46
Inventory Planning	2.86	4.02	0.10	0.73
Queuing Theory	2.84	2.84	0.41	0.20
Linear Programming	2.14	2.35	0.55	0.80
Simulation Modeling	1.65	1.93	0.30	0.48

Appendix I: T-test

<u>Subject</u>	<u>T Value</u>	<u>P Value</u>
Queuing Theory	-0.01	0.995
R & D Management	-0.02	0.983
Business Law	0.03	0.975
Entrepreneurship	0.12	0.903
Personnel Management	-0.15	0.881
Network Modeling	0.18	0.860
Labor Relations	-0.19	0.851
Decision Theory	-0.28	0.783
Innovation Technique	-0.34	0.733
Group Projects	-0.35	0.728
Real Estate Acquisition & Disp	0.42	0.672
Master Planning	-0.47	0.639
Technical Writing	-0.49	0.625
Communication	-0.58	0.566
CAD / CAM	0.58	0.565
Strategic Planning	-0.59	0.556
Linear Programming	0.77	0.442
Marketing	-0.78	0.435
Interior Design	0.79	0.432
Computer Systems Design	-0.88	0.378
Architectural Design	-0.93	0.352
Computer Science	-0.94	0.347
Statistical Analysis	-0.97	0.335
Professional Ethics	-1.02	0.308
Public Policy	-1.06	0.293
Financial Management	1.13	0.260
Behavioral Science	-1.15	0.251
Simulation Modeling	1.21	0.231
Organizational Theory	-1.34	0.182
Life Cycle Costing	1.75	0.082
Quality Control	1.81	0.073
Building Programming	1.82	0.071
Collective Bargaining	1.82	0.071
Management Principles	-1.94	0.055
Project Management	1.95	0.053
Construction Management	2.08	0.040
Computer Room Design	2.17	0.032
Forecasting	2.22	0.028
Engineering Economy	2.49	0.014
Budget Preparation	2.66	0.009
Contract Policy	2.66	0.009
Industrial Engineering	2.70	0.008
Information Systems	-2.69	0.008
Leadership	-2.73	0.007
Cost Accounting	2.95	0.004

Appendix I (Continued)

<u>Subject</u>	<u>T Value</u>	<u>P Value</u>
Inventory Planning	3.24	0.002
Managerial Accounting	3.09	0.002
Public Speaking	-3.54	0.001
Energy Management	6.04	0.000
Safety Engineering	5.52	0.000
Mechanical Engineering	5.30	0.000
Installation & Space Mgt	5.23	0.000
Energy Efficient Designs	4.71	0.000
Building Fire Protection	4.62	0.000
Value Engineering	4.44	0.000
Electrical Engineering	4.38	0.000
Facility Operations	4.22	0.000
Maintenance Management	4.15	0.000
Civil Engineering	-3.92	0.000

Appendix J: Programs and Data

SPSSX Program for Military Data

```
TITLE          THESIS RESEARCH
FILE HANDLE    THESIS / NAME = 'mil.dat'
DATA LIST      FILE = THESIS FIXED RECORDS = 3 /
SURVEYNO,X1,X2,X3,X4,X5,X6,X7,X8,X9,X10,
X11,X12,X13,X14,X15,X16,X17,X18,X19,X20,
X21,X22,X23,X24,X25,X26,X27,X28,X29,X30,
X31,X32,X33,X34,X35,X36,X37,X38,X39,X40,
X41,X42,X43,X44,X45,X46,X47,X48,X49,X50,
X51,X52,X53,X54,X55,X56,X57,X58,X59,X60,
X61,X62,X63,X64,X65,X66,X67,X68,X69,X70,
X71,X72,X73,X74,X75,X76,X77,X78,X79,X80,
X81,X82,X83,X84,X85,X86,X87,X88,X89,X90,
X91,X92,X93,X94,X95,X96,X97,X98,X99,X100,
X101,X102,X103,X104,X105,X106,X107,X108,
X109,X110,X111,X112,X113,X114,X115,X116,
X117,X118,X119,X120,X121,X122,X123,X124,
X125,X126,X127,X128,X129,X130,X131,X132,
X133,X134,X135,X136,X137,X138,X139,X140,
X141,X142,X143,X144,X145,X146,X147,X148,
X149,X150,X151,X152,X153,X154,X155,X156,
X157,X158,X159,X160,X161,X162,X163,X164,
X165,X166,X167,X168,X169,X170,X171,X172,
X173,X174,X175,X176,X177,X178,X179,X180,
X181,X182
(F8.0,52F1.0 / 60F1.0 / 60F1.0 / 10F1.0)

SET           BLANKS = 9 / WIDTH = 80
MISSING VALUES SURVEYNO TO X182 (9)

VALUE LABELS   X178 1 'UPPER MANAGEMENT'
                2 'MIDDLE MANAGEMENT'
                3 'FIRST LEVEL MANAGER'
                4 'ENGINEER' 5 'OTHER' /
X179 1 'LIEUTENANT' 2 'CAPTAIN'
                3 'MAJOR' 4 'LT COLONEL' /
X180 1 '0-6 YEARS' 2 '7-10 YEARS'
                3 '11-15 YEARS'
                4 '16-20 YEARS' 5 '21-25 YEARS'
                6 '26-30 YEARS' 7 'OVER 30 YEARS' /
X181 1 'BACHELOR' 2 'MASTER'
                3 'DOCTORATE' /
X182 1 '$0-1K' 2 '$1K-10K' 3 '$10K-100K'
                4 '$100K-500K' 5 '$500K-1M' 6 '$OVER $1M'

COMPUTE        NEED1 = X2 - X1
COMPUTE        NEED2 = X5 - X4
COMPUTE        NEED3 = X8 - X7
```

COMPUTE	NEED4 = X11 - X10
COMPUTE	NEED5 = X14 - X13
COMPUTE	NEED6 = X17 - X16
COMPUTE	NEED7 = X20 - X19
COMPUTE	NEED8 = X23 - X22
COMPUTE	NEED9 = X26 - X25
COMPUTE	NEED10 = X29 - X28
COMPUTE	NEED11 = X32 - X31
COMPUTE	NEED12 = X35 - X34
COMPUTE	NEED13 = X38 - X37
COMPUTE	NEED14 = X41 - X40
COMPUTE	NEED15 = X44 - X43
COMPUTE	NEED16 = X47 - X46
COMPUTE	NEED17 = X50 - X49
COMPUTE	NEED18 = X53 - X52
COMPUTE	NEED19 = X56 - X55
COMPUTE	NEED20 = X59 - X58
COMPUTE	NEED21 = X62 - X61
COMPUTE	NEED22 = X65 - X64
COMPUTE	NEED23 = X68 - X67
COMPUTE	NEED24 = X71 - X70
COMPUTE	NEED25 = X74 - X73
COMPUTE	NEED26 = X77 - X76
COMPUTE	NEED27 = X80 - X79
COMPUTE	NEED28 = X83 - X82
COMPUTE	NEED29 = X86 - X85
COMPUTE	NEED30 = X89 - X88
COMPUTE	NEED31 = X92 - X91
COMPUTE	NEED32 = X95 - X94
COMPUTE	NEED33 = X98 - X97
COMPUTE	NEED34 = X101 - X100
COMPUTE	NEED35 = X104 - X103
COMPUTE	NEED36 = X107 - X106
COMPUTE	NEED37 = X110 - X109
COMPUTE	NEED38 = X113 - X112
COMPUTE	NEED39 = X116 - X115
COMPUTE	NEED40 = X119 - X118
COMPUTE	NEED41 = X122 - X121
COMPUTE	NEED42 = X125 - X124
COMPUTE	NEED43 = X128 - X127
COMPUTE	NEED44 = X131 - X130
COMPUTE	NEED45 = X134 - X133
COMPUTE	NEED46 = X137 - X136
COMPUTE	NEED47 = X140 - X139
COMPUTE	NEED48 = X143 - X142
COMPUTE	NEED49 = X146 - X145
COMPUTE	NEED50 = X149 - X148
COMPUTE	NEED51 = X152 - X151
COMPUTE	NEED52 = X155 - X154
COMPUTE	NEED53 = X158 - X157
COMPUTE	NEED54 = X161 - X160
COMPUTE	NEED55 = X164 - X163

```

COMPUTE NEED56 = X167 - X166
COMPUTE NEED57 = X170 - X169
COMPUTE NEED58 = X173 - X172
COMPUTE NEED59 = X176 - X175

COMPUTE AQUAN = MEAN (X1,X4,X7,X10,X13,X16,X19,X22)
COMPUTE AQUAL = MEAN (X25,X28,X31,X34,X37,X40,X43)
COMPUTE AFIN = MEAN (X46,X49,X52,X55,X58,X61,X64)
COMPUTE APROJ = MEAN (X67,X70)
COMPUTE AE1 = MEAN (X73,X79,X79,X82,X85)
COMPUTE AE2 = MEAN (X88,X91,X94,X97,X100)
COMPUTE AENGR = MEAN (AE1,AE2)
COMPUTE AF1 = MEAN (X103,X106,X109,X112,X115)
COMPUTE AF2 = MEAN (X127,X130,X133,X136,X139)
COMPUTE AF3 = MEAN (X145,X152,X154,X157,X160)
COMPUTE AF4 = MEAN (X166,X169,X124,X148,X172)
COMPUTE AF5 = MEAN (X118,X121,X142,X163,X175)
COMPUTE AFUN = MEAN (AF1,AF2,AF3,AF4,AF5)

COMPUTE SQUAN = MEAN (X2,X5,X8,X11,X14,X17,X20,X23)
COMPUTE SQUAL = MEAN (X26,X29,X32,X35,X38,X41,X44)
COMPUTE SFIN = MEAN (X47,X50,X53,X56,X59,X62,X65)
COMPUTE SPROJ = MEAN (X68,X71)
COMPUTE SE1 = MEAN (X74,X77,X80,X83,X86)
COMPUTE SE2 = MEAN (X89,X92,X95,X98,X101)
COMPUTE SENGR = MEAN (SE1,SE2)
COMPUTE SF1 = MEAN (X104,X107,X110,X113,X116)
COMPUTE SF2 = MEAN (X128,X131,X134,X137,X140)
COMPUTE SF3 = MEAN (X152,X155,X158,X161,X164)
COMPUTE SF4 = MEAN (X125,X146,X149,X170,X173)
COMPUTE SF5 = MEAN (X119,X122,X143,X167,X176)
COMPUTE SFUN = MEAN (SF1,SF2,SF3,SF4,SF5)

COMPUTE IQUAN = MEAN (X3,X6,X12,X15,X18,X21,X24)
COMPUTE IQUAL = MEAN (X27,X30,X33,X36,X39,X42,X45)
COMPUTE IFIN = MEAN (X48,X51,X54,X57,X60,X63,X66)
COMPUTE IPROJ = MEAN (X69,X72)
COMPUTE IE1 = MEAN (X75,X78,X81,X84,X87)
COMPUTE IE2 = MEAN (X90,X93,X96,X99,X102)
COMPUTE IENGR = MEAN (IE1,IE2)
COMPUTE IF1 = MEAN (X105,X108,X111,X114,X117)
COMPUTE IF2 = MEAN (X129,X132,X135,X138,X141)
COMPUTE IF3 = MEAN (X153,X156,X159,X162,X165)
COMPUTE IF4 = MEAN (X123,X126,X147,X150,X174)
COMPUTE IF5 = MEAN (X120,X144,X168,X171,X177)
COMPUTE IFUN = MEAN (IF1,IF2,IF3,IF4,IF5)

COMPUTE NQUAN = MEAN (NEED1 TO NEED8)
COMPUTE NQUAL = MEAN (NEED9 TO NEED15)
COMPUTE NFIN = MEAN (NEED16 TO NEED22)
COMPUTE NPROJ = MEAN (NEED23,NEED24)
COMPUTE NENGR = MEAN (NEED25 TO NEED34)

```

```
COMPUTE      NFUN = MEAN (NEED35 TO NEED59)

FREQUENCIES  VARIABLES = X178 (1,5) X179 (1,4) X180 (1,7)
              X181 (1,3) X182 (1,6) /
              STATISTICS = DEFAULT

FREQUENCIES  VARIABLES = NEED1 TO NEED59 X3 X6 X9 X12 X15
              X18 X24 X27 X30 X33 X36 X39 X42 X45 X48 X51
              X54 X57 X60 X63 X66 X69 X71 X73 X75 X78 X81
              X84 X87 X90 X93 X96 X99 X102 X105 X108 X111
              X114 X117 X120 X123 X126 X129 X132 X135 X138
              X141 X144 X147 X150 X153 X156 X159 X162 X165
              X168 X171 X174 X177 AQUAN AQUAL AFIN APROJ
              AENGR AFUN SQUAN SQUAL SFIN SPROJ SENGR SFUN
              IQUAN IQUAL IFIN IPROJ IENGR IFUN NQUAN
              NQUAL NFIN NPROJ NENGR NFUN /
              FORMAT = ONEPAGE /
              STATISTICS = RANGE MEAN MEDIAN STDEV
              VARIANCE /
```

Military Data

000012341111111116661111111111115555544422266666655555552222
221114446665554445555544444411133322222111444222111444222
225566655522211144422553335552221112224441112221114445556
6622242226
0000123712211112222 2447775674453325552333551111222
22343354 243254222457 245565 324255
355557777255111221222434 667 332666244225121 2
44 22126
00001238334111111234111 111111666444333 22 444223
111 111 33111 333
444
1212
000012393336671133333332242244465575574563334471153562251151
161163352251164473353361131131151131136663356661135556661131
1366666777556224114113344112444115115225667112111134461161
161132226
00001240111112111244233334446775777776667775773664555764653
35554777777776775342251141141143352244572243343255675672553
3713313365577711111212111345771351151333571155771133673772
3622623326
0000124122233411144422233111114444443344454474674673662222
222224553662223542222552562443343554664774553442334453323563
33445336456333332242?234422236335334336356332233353363363
3633422226
000012421251251352454551251151354554554554554454554554452552
454554552353452343443352352353352352354553453452353554552452
353453555564554554552353554556662352254552352354552252252253
3522522326

00001243111114 2341131131121144574574571246677772353341141
 17114445444114446557227114114116115227777225114116777772257
 74777777771111131131146661117771451451134471131131122271161
 1711522126
 00001234111111111666111111111115555544422666665555552222
 2211144466655544455554444441133222221144222114442222
 225556665552221144422553335522211222444111222114445556
 6622242226
 0000123712211122222 2447775674453325552333551111222
 22343354 243254222457 245565 324255
 355557777255111221222434 667 332666244225121 2
 44 22126
 00001238334111111234111 111111666444333 22 444223
 111 111 33111 333
 444 1212
 00001239333667113333332242244465575574563334471153562251151
 161163352251164473353361131131151131136663356661135556661131
 1366666777556224114113441124441151152256671121111134461161
 1611322226
 0000124011111211124423334446775777776667775773664555764653
 355547777777776775342251141141143352244572243343255675672553
 3713313365577711111212111345771351151333571155771133673772
 3622623326
 000012412223341114442223311111444443344454474674673662222
 222224553662223542222552562443343554664774553442334453323563
 334453364563333322422234422236335334336356333223353363363
 3633422226
 000012421251251352454551251151354554554554454554554452552
 454554552353452343443352353352352354553453452353554552452
 35345355564554554552353554556662352254552352354552252252253
 3522522326
 00001243111114 2341131131121144574574571246677772353341141
 17114445444114446557227114114116115227777225114116777772257
 74777777771111131131146661117771451451134471131131122271161
 1711522126
 00001244222234112567567344114566775666666675163664664665
 66446224446666556566335224224224223234233345233566662252
 247777677776665662224567675667772261155567773333334462262
 2522352226
 000012453345661444431115522235534223112111556227456111111
 2111111221222 777776773311111165665642211323211666665232
 1156666666111211311566311116666666333666111113226263333
 3321142226
 00001236 4111 3235222222 311366666776333777666333 4 4
 5 5 4 5 5 5236 7 6 6 6 5 5113 5 5 6224334 3
 3666777777 4 4 4 4445 3777446114334 3 4 4 4 6 6
 6 622121
 000012351211211111123311111111567676777465566665554443431
 21222444332343555676444222223334445554614333644444613211211
 1177777777555773334446675447775556556773335444332224445554
 444422126

00002633111333111464222221222246333444222576555444111222
 2222465222223366333333334433333222222233222466225
 55676777777222223344553336676667655555332222255666
 6666612126
 00002634111221111232111111111115673335661117777733223111
 111114441111111166611111111111111126611111111143111111
 115766771111411111111156411154711111132656111111111111111
 1111123125
 00002635231346111577476333577775774544763335773655664664663
 44344344465344676577354365354752354333576577454455733655333
 43577557553332224653324544467745435456745435432356565774
 6546522326
 000026371312321334541112221113432463463442234663463351121223
 553452255663554552424352242241113643442241123453344564661242
 343343665662232222423345422445522322222354552443443352242
 222222221
 00002642222524212334323513413422577566557445677777573663444
 123115775552652425665466366445456256 14557763446423333111
 116776667772113554553114673117775773773337775773665556774776
 7746622226
 000026431113341156774443464463363374475562455671374552113323
 33111556134225556666555335335224226226335353322234434461151
 1167777445333666435223332216673343343333333333335564454
 442222226
 0000264511132211222122112111234457346345111333345555233113
 37113133123225224335351131131133332232241122231134463362441
 11235446444234111124113333113337126115112355233331121231131
 1311322225
 000026462225551114542213345562227777777543777566565645443
 335767766677777557556556556556556664465563465676677777
 77434556556111353333333322577555444545666466111776667775
 554442126
 000026472224661112335511133322666655577777775554444442
 542343446662226665555722322222223345344344333445551141
 242345677771231251231231233334561141131143444531144447775555
 555512126
 0000264811124211122211114211111157634356522677776774542534
 6422256655623245533246723525523345656555445556563334564775
 66666667773552335666774556677777724624367755111567775215
 2152122226
 000026493225431 15333 13 12115 16776665663225556776773114117
 5631132167777655556773453454335564564464553445664575562442
 3356656776744532233334455422266632221432455355244344664665
 6656622226
 0000265135466634356566645445635447746766656466665776655645
 5556466677755577566 777 3576775655656655655655674656
 647776756662224556665756661117772232224436665673436667773546
 7735432126
 0000265822244422267755544433333445435556444771166664452213
 35445557774467777775674561125565566676675545546676673373
 377777777767776676675564447773351115552266672242246673252
 2511152221

000026611342	1	21	235612	3472353	7	4	475663	11	1124
47	2	1	44	3	12		246111111113335457111		
1	35676771121	2241125	71	2446	131121133451	41132352251	51		
2511312123									
00002683121232122111111321122133453434352224463453354665543									
3324355556732344435555666662323435663436666767673542222324									
44676777775543334433254121767554443355566565222766667									
7776732226									
00002685					554		666655		
	664776666						646434		
777777		544		777					
33121									
000026861112141111241141141142244454455771146777771241141152									
261143341141141146661171111141141141142241111141144241461171									
14777771111141111143245671117771141113351142261141141141141									
1411453321									
00002700121111	164166111111565766666661227773772662663667								
24555166577334421466546244244112342443771114443663774771111									
66477575772444442443773662117771462462774673333773774663133									
1334352222									
000027031211431543441111111344567333566111566667664551113									
331115554654444456645544444111221222	4331111114435553331								
116666666666	222222	333	6664434543335544442331114542111						
1134322224									
0000270421222211144733711111235567567567237336557772243354									
452263356674453365575522222333772232452232223341116002231									
1167766766755545522311145735745722222222232223331123352221									
1233422224									
000027061222321221211111111112221211112111111232232121									
32111222222432221114433333222332212234333232222331112									
22232333342221112211233223452221112323454442232224552323									
4323242221									
00002707114337111557127777117557777777777075777007777777777									
4777732777744077777437111111532411377722445216777777777777									
1177777777743422511411254631777721416114777225222243471142									
2422652126									
0000270911116671113511211411433445712422433777446030331121									
2444744733622564777714112113113132442455744033312444403124									
33777777772232322444577333777135135123444555222246031121									
5555552221									
000029681411361117771771671161561571571571537772717747771									
37127477117137077577117117117137117117577117117117677777777									
1737777777117115117135777135777117117117111117117111114117117									
17117									
000041033335551113322233332260655555444555505533333333333									
333334444444466644455544444444455544444444222333344433333333									
22333555552223322222332223322222222223322222066333333									
3322213326									
00004104222355332555444343443335654445553445776775004444444									
5444455444466555566677454454454344344344454566454445003503									
555776776663333333663555663337775664064444663663322433004604									
6535413126									

0000443846646611256722244435246777557667445666777225666665
o75565562264665565445557556556446556445552234451124561234
5455634456634522556744656745665552241156665652232267776776
6722522226
000045072411112114114114112112116664144341116365243112143111
11521333311311631535524 5241211115461115
34711666111657515444 42211164711111324111425111311o166466
45555
00004727121111 131131155 1324752533762116773752122334541
32354133354354254132257157157133235277111152111173111167
677122243 153152 111 677152 111111 4551224
7717522126

AD-A187 836

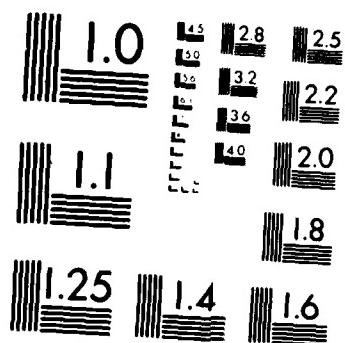
AN INVESTIGATION OF EDUCATIONAL REQUIREMENTS IN
FACILITIES ENGINEERING(U) AIR FORCE INST OF TECH
WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. D M KREAG
UNCLASSIFIED SEP 87 AFIT/GEM/LSM/87S-14

2/2

F/G 5/6

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1964 A

SPSSX Program for Civilian Data

TITLE THESIS RESEARCH
FILE HANDLE THESIS / NAME = 'civ.dat'
DATA LIST FILE = THESIS FIXED RECORDS = 3 /
SURVEYNO,X1,X2,X3,X4,X5,X6,X7,X8,X9,X10,
X11,X12,X13,X14,X15,X16,X17,X18,X19,X20,
X21,X22,X23,X24,X25,X26,X27,X28,X29,X30,
X31,X32,X33,X34,X35,X36,X37,X38,X39,X40,
X41,X42,X43,X44,X45,X46,X47,X48,X49,X50,
X51,X52,X53,X54,X55,X56,X57,X58,X59,X60,
X61,X62,X63,X64,X65,X66,X67,X68,X69,X70,
X71,X72,X73,X74,X75,X76,X77,X78,X79,X80,
X81,X82,X83,X84,X85,X86,X87,X88,X89,X90,
X91,X92,X93,X94,X95,X96,X97,X98,X99,X100,
X101,X102,X103,X104,X105,X106,X107,X108,
X109,X110,X111,X112,X113,X114,X115,X116,
X117,X118,X119,X120,X121,X122,X123,X124,
X125,X126,X127,X128,X129,X130,X131,X132,
X133,X134,X135,X136,X137,X138,X139,X140,
X141,X142,X143,X144,X145,X146,X147,X148,
X149,X150,X151,X152,X153,X154,X155,X156,
X157,X158,X159,X160,X161,X162,X163,X164,
X165,X166,X167,X168,X169,X170,X171,X172,
X173,X174,X175,X176,X177,X178,X179,X180,
X181,X182,X183
(F8.0,52F1.0 / 60F1.0 / 60F1.0 / 11F1.0)

SET BLANKS = 9 / WIDTH = 80
MISSING VALUES SURVEYNO TO X183 (9)

VALUE LABELS X178 1 'UPPER MANAGEMENT'
 2 'MIDDLE MANAGEMENT'
 3 'FIRST LEVEL MANAGER'
 4 'ENGINEER' 5 'OTHER' /
X179 1 'MANUFACTURING'
 2 'NONMANUFACTURING' /
X180 1 '0-6 YEARS' 2 '7-10 YEARS'
 3 '11-15 YEARS' 4 '16-20 YEARS'
 5 '21-25 YEARS' 6 '26-30 YEARS'
 7 'OVER 30 YEARS' /
X181 1 'HIGH SCHOOL' 2 'ASSOCIATE'
 3 'BACHELOR' 4 'MASTER' 5 'DOCTORATE' /
X182 1 'ENGINEERING' 2 'MANAGEMENT'
 3 'OTHER' /
X183 1 '\$0-100K' 2 '\$100K-500K' 3 '\$500K-1M'
 4 '\$1M-5M' 5 '\$5M-10M' 6 '\$10M-15M'
 7 '\$OVER \$15M'

COMPUTE NEED1 = X2 - X1
COMPUTE NEED2 = X5 - X4
COMPUTE NEED3 = X8 - X7

COMPUTE	NEED4 = X11 - X10
COMPUTE	NEED5 = X14 - X13
COMPUTE	NEED6 = X17 - X16
COMPUTE	NEED7 = X20 - X19
COMPUTE	NEED8 = X23 - X22
COMPUTE	NEED9 = X26 - X25
COMPUTE	NEED10 = X29 - X28
COMPUTE	NEED11 = X32 - X31
COMPUTE	NEED12 = X35 - X34
COMPUTE	NEED13 = X38 - X37
COMPUTE	NEED14 = X41 - X40
COMPUTE	NEED15 = X44 - X43
COMPUTE	NEED16 = X47 - X46
COMPUTE	NEED17 = X50 - X49
COMPUTE	NEED18 = X53 - X52
COMPUTE	NEED19 = X56 - X55
COMPUTE	NEED20 = X59 - X58
COMPUTE	NEED21 = X62 - X61
COMPUTE	NEED22 = X65 - X64
COMPUTE	NEED23 = X68 - X67
COMPUTE	NEED24 = X71 - X70
COMPUTE	NEED25 = X74 - X73
COMPUTE	NEED26 = X77 - X76
COMPUTE	NEED27 = X80 - X79
COMPUTE	NEED28 = X83 - X82
COMPUTE	NEED29 = X86 - X85
COMPUTE	NEED30 = X89 - X88
COMPUTE	NEED31 = X92 - X91
COMPUTE	NEED32 = X95 - X94
COMPUTE	NEED33 = X98 - X97
COMPUTE	NEED34 = X101 - X100
COMPUTE	NEED35 = X104 - X103
COMPUTE	NEED36 = X107 - X106
COMPUTE	NEED37 = X110 - X109
COMPUTE	NEED38 = X113 - X112
COMPUTE	NEED39 = X116 - X115
COMPUTE	NEED40 = X119 - X118
COMPUTE	NEED41 = X122 - X121
COMPUTE	NEED42 = X125 - X124
COMPUTE	NEED43 = X128 - X127
COMPUTE	NEED44 = X131 - X130
COMPUTE	NEED45 = X134 - X133
COMPUTE	NEED46 = X137 - X136
COMPUTE	NEED47 = X140 - X139
COMPUTE	NEED48 = X143 - X142
COMPUTE	NEED49 = X146 - X145
COMPUTE	NEED50 = X149 - X148
COMPUTE	NEED51 = X152 - X151
COMPUTE	NEED52 = X155 - X154
COMPUTE	NEED53 = X158 - X157
COMPUTE	NEED54 = X161 - X160
COMPUTE	NEED55 = X164 - X163

```

COMPUTE NEED56 = X167 - X166
COMPUTE NEED57 = X170 - X169
COMPUTE NEED58 = X173 - X172
COMPUTE NEED59 = X176 - X175

COMPUTE AQUAN = MEAN (X1,X4,X7,X10,X13,X16,X19,X22)
COMPUTE AQUAL = MEAN (X25,X28,X31,X34,X37,X40,X43)
COMPUTE AFIN = MEAN (X46,X49,X52,X55,X58,X61,X64)
COMPUTE APROJ = MEAN (X67,X70)
COMPUTE AE1 = MEAN (X73,X76,X79,X82,X85)
COMPUTE AE2 = MEAN (X88,X91,X97,X100)
COMPUTE AENGR = MEAN (AE1,AE2)
COMPUTE AF1 = MEAN (X103,X106,X109,X112,X115)
COMPUTE AF2 = MEAN (X127,X130,X133,X136,X139)
COMPUTE AF3 = MEAN (X152,X154,X157,X160,X163)
COMPUTE AF4 = MEAN (X121,X124,X145,X148,X172)
COMPUTE AF5 = MEAN (X118,X142,X166,X169,X175)
COMPUTE AFUN = MEAN (AF1,AF2,AF3,AF4,AF5)

COMPUTE SQUAN = MEAN (X2,X5,X8,X11,X14,X17,X20,X23)
COMPUTE SQUAL = MEAN (X26,X29,X32,X35,X38,X41,X44)
COMPUTE SFIN = MEAN (X47,X50,X53,X56,X59,X62,X65)
COMPUTE SPROJ = MEAN (X68,X71)
COMPUTE SE1 = MEAN (X74,X77,X80,X83,X86)
COMPUTE SE2 = MEAN (X89,X92,X95,X98,X101)
COMPUTE SENGR = MEAN (SE1,SE2)
COMPUTE SF1 = MEAN (X104,X107,X110,X113,X116)
COMPUTE SF2 = MEAN (X128,X131,X134,X137,X140)
COMPUTE SF3 = MEAN (X152,X155,X158,X161,X164)
COMPUTE SF4 = MEAN (X119,X125,X149,X173,X176)
COMPUTE SF5 = MEAN (X122,X143,X146,X167,X170)
COMPUTE SFUN = MEAN (SF1,SF2,SF3,SF4,SF5)

COMPUTE IQUAN = MEAN (X3,X6,X12,X15,X18,X21,X24)
COMPUTE IQUAL = MEAN (X27,X30,X33,X36,X39,X42,X45)
COMPUTE IFIN = MEAN (X48,X51,X54,X57,X60,X63,X66)
COMPUTE IPROJ = MEAN (X69,X72)
COMPUTE IE1 = MEAN (X75,X78,X81,X84,X87)
COMPUTE IE2 = MEAN (X90,X93,X96,X99,X102)
COMPUTE IENGR = MEAN (IE1,IE2)
COMPUTE IF1 = MEAN (X105,X108,X111,X114,X117)
COMPUTE IF2 = MEAN (X129,X132,X135,X138,X141)
COMPUTE IF3 = MEAN (X153,X156,X159,X162,X165)
COMPUTE IF4 = MEAN (X120,X126,X150,X174,X177)
COMPUTE IF5 = MEAN (X123,X144,X147,X168,X171)
COMPUTE IFUN = MEAN (IF1,IF2,IF3,IF4,IF5)

COMPUTE NQUAN = MEAN (NEED1 TO NEED8)
COMPUTE NQUAL = MEAN (NEED9 TO NEED15)
COMPUTE NFIN = MEAN (NEED16 TO NEED22)
COMPUTE NPROJ = MEAN (NEED23,NEED24)
COMPUTE NENGR = MEAN (NEED25 TO NEED34)

```

```

COMPUTE      NFUN = MEAN (NEED35 TO NEED59)

FREQUENCIES  VARIABLES = X178 (1,5) X179 (1,2) X180 (1,7)
              X181 (1,5) X182 (1,4) X183 (1,7) /
              STATISTICS = DEFAULT

FREQUENCIES  VARIABLES = NEED1 TO NEED59 X3 X6 X9 X12
              X15 X18 X24 X27 X30 X33 X36 X39 X42 X45
              X48 X51 X54 X57 X60 X63 X66 X69 X71 X73
              X75 X78 X81 X84 X87 X90 X93 X96 X99 X102
              X105 X108 X111 X114 X117 X120 X123 X126
              X129 X132 X135 X138 X141 X144 X147 X150
              X153 X156 X159 X162 X165 X168 X171 X174
              X177 AQUAN AQUAL AFIN APROJ AENGR AFUN
              SQUAN SQUAL SFIN SPROJ SENGR SFUN IQUAN
              IQUAL IFIN IPROJ IENGR IFUN NQUAN NQUAL
              NFIN NPROJ NENGR NFUN /
              FORMAT = ONEPAGE /
              STATISTICS = RANGE MEAN MEDIAN STDEV
              VARIANCE /

```

Civilian Data

```

00001459344566123577366354334122565554442445553562563442333
53122363577376466355766766766443766766346766667666466463567
665557654427541214542424651217772442642237677672533647675667
67666215416
00001458221111111223451111111344444111111345674564564674
77777777774433422234457777336627724634341221241132671
772443774771334662341231221226774565771116776771336774776777
77233115314
0000145413 334    344556244345   345    344    221556244355256
        46656626646636634446646636534344   566244355
        646624444444   456334          356456366223456466   36646666 4
66466213214
0000145113145511134422211366256444556672436675663442553453
671344445552666674552345674661441343442255344661221221443
433332245551111133323222115564456661222334441134565677777
77377214414
00001446111577146456456135111135666455772347775672224553447
772454554555677775655555553545554441774445575552474661661
35666356777133346777455247117552462461237775574563452333441
22244224412
0000144324412312333233342452224453443342336676775564454456
775567777755677766755655655633455644567777777775565562226
6777777777445445664456674457774433355677777667777777777
77777112414
000014402232231233345552255226674444674675674774774564563
5635656745645644434444444244244244344234774665552233442332
22467577477233222456222332226773443443444675772333565666666
66566222314

```

000014311111111111111111351116673575572 622713 2 71172
 22113227447 675571143357774471133353361112273375571111111232
 2255711744711111111153371115571141161142275571113372262573
 3545741724
 0000142923233344 333111323 4411167656643445 6677775455565655
 446664674665664553663554555662455556662226664664561113551114
 55355356455 555 3565662551113666661553556667775
 77577211242
 00001427111355111233 1216765764663335775666774666775
 77343777677464677566566366366565545666354555666772225664443
 33566666444455333566566566311057444466555776664336777666777
 77677
 00001426221444111444444222143221455462444443441336665555556
 6634466666555666666666656666444555356666663444554552222
 3324523244412211266623111111455111111126455455333666662664
 66366216212
 00001424 575 344 444232455111565444343444
 444565777777 777 1 77777777142 155
 4464677777336 227346444 777 666447 55777773373
 37777314314
 00001423122355111333544133645444555225542433334342445446443
 435347552432225512223255443777233116553343332334345443331
 11322333544222423553432433133552232223432434331213433336744
 53333312313
 00001417233333 244 333111345111222445111111113
 22 45625523322211133333 344222111355344 3331
 11233322666 2221 577 7 7 4 2333366676
 77777322213
 00001416332453133444466211631116665664661436765675676665673
 675675757747767757746667757737744422232236647757722233334
 45566366366444322221112444224663222332332554664113556775775
 77577221314
 0000141411144411135534533133543667667553327776666655565562
 45244565566466466555344255244344243551673442452561561671441
 566666765663322334541215574445774446663225664541344565555667
 77666223436
 00001412 333 666444567555674565774775774556664
 44444666 4445674565556712255522111111446666556444666111
 56666656656656552245645577577577677555 1115672231
 12333223214
 00001409322676 255577666766222777777677777777455777774
 33777555222444777 222333444444 11177777222444666111
 777777776667777744422277777666222333777444 4473332
 22111126112
 00001407131465121556677676555332667366757577 75477377566 325
 5455667777 324347557112555667667435457334667647224343333557
 7766677746736667 577257367477771141111225676773225665672334
 55355115314
 00001403 1323 353267 346113564146121 241346
 136 357137355243 311133 147237226337243666
 447357357447777 455567777 257777111 3371131231
 45246224311

00001390254111 267143 132 3521114563443442442541311212
 45 3 1144123577234464464666444 12311513675665661421211212
 31444556265 1 111 1 1131 445 1131 1564466 1214454464
 45677314144
 00001386121443111325542125654577744466512165577776665665
 665557777777777666444444445555566666777666555222332226
 667776666664443354444666111677767774477777546767777777
 77777224324
 000013852432321112222211111344333334342225453335453332222
 222225454344465665643476765632354543421266666767212 2 17
 57656566663222 2222222546 1176743422224656767111656777777
 7776732331
 00001384546765323667567746331722655545412354657776553544537
 55454777777777775654477777545666757757577555777775347777
 775542367746744531365732132265656734654577777522756777777
 77777211316
 000013833432233233445452334543235454654453336677673454564446
 764334555673774454664454444455544444554444566465456676675
 556563364575544566766655735566555553566676661144345675553
 55456312312
 0000138112125611134411111244111466355441115575552213434435
 55111554233143 4663541115663664772334444553562224422324545
 677233444 4552222431114411132231243445 6663456772
 46455213414
 00001374122221111111111132111455333332112334552211221112
 221114453443322223334456546534433345434444433443232222431
 443444444541111112233223211133222331114543541213545665654
 66455223314
 000013722322651112324553335664445666775672446776765556774447
 7755577756655577755444777772334447713377336663554554544
 4477776777744411133577772227744444337777744777777777
 7755317215
 00001368112561441231131341363561273676671175371265673371143
 371271263572254676672356664672451343672575672572573672571361
 366673675571342575671463561165672261141136665551136675675675
 67567411412
 00001367222233111222222233111444455455226676676675666667
 6722366677766767766444666775555566222776665551112222224
 4466676677766622245221222 7776666666666666666777777777
 77777212314
 0000136311124411124511111677444677677677111777774774444444
 2224444411157711122211144444447111111666111441114466772211
 114444674672222234411135746746756646722234424422111237777
 77235216327
 00001358254343133143464144266143476265466255575662553661552
 66144376 65155255365133466466366233444133465 5515423266 541
 44366576577 21466144 476 666 66565 2266566 23664665664
 66254226316
 00001354111455121232332121232121443343455111455566333444333
 431214442323437777734434435533312145511123266644333222112
 2267734367734422211111121111777343111116773451111215666667
 77345312314

00001353132121111324445555666755657772335643556665664546
 7632224256532234367633777777755444141552327664433431211
 213554544564542325653335661214552226763223335651216766552222
 22332212311
 00001352 111111333222111111133333111113351151152223333
 3355555666667773322772211133552477777777711222112
 2234424456712211222112221145714414524447337113373371442
 44357417313
 0000135022222211773121132255656666666111434555666111116
 6623333377666667755666775544432355666333666776675563
 4455644544511111556444451144433334111335111114454455565
 55557211242
 0000134455566654777556666766544777567666556766756767777777
 6775677755555677666344443356744433344433666444444453333
 333336676776675665555666555663336673476663333346664565565
 55335112332
 0000134312233311111223331112223443332225556663143333333333
 3333333441115522211177722333111115533344466611111337
 771111113333311155555222222233311111336661111227772224
 44555416144
 0000133523223211233111233666222666355455 5777772444667774
 5545577725566667746535556656233365466244677376577223333652
 22466466677333 444666366111777244 265677771223663566776
 77457211312
 0000133014456613366766666553336774666677777777666666675
 67466566366366577567525365166661333561673776772561771771674
 44666556377377123257255677475671351473572674777364774663664
 77477213314
 00001326111222222665356444315235677677577546677777775773454
 774476574364366675672262262262151143373465472172265473271
 11567577372154473562455773556661257773457572264353463262363
 46466124315
 00001322344443111565111321354222566444233222556566555455564
 3333366634343356622234466656611122244522256666566111555563
 3356644421111111556355444111666 455555555 6665557776
 66555215214
 0000132146657755566777467775565566675556676675564555566676
 665556675665566775665577765666555445556667667667555554443
 3455544545522233567556344223667224556345667677323566667777
 77676155143
 0000132025546624414425513336513267736746613324456655545664
 44322566667445664334346664445554335442576772455662672442564
 556666667754544556733445545567755555344567566345566775666
 77555215314
 00001319222556 555456444465555566556332556665555556665
 5544366667555665554455545532555562335565555662224453555
 555565545562332224433445 666222 2226665564446665665666
 66666217415
 000013183525562446666634456633266666656343666664555555555
 66333666556355345344555553444445564552444554555661232333553
 5566666666344344344244233133566244255255455666664555666666
 66466211326

000013151225663335566622344455664665445555664564444564564
 455565556645666734434634444444443343334566673343334444343
 34444345433555554443344533656654544444667554444446673444
 45334215331
 000013141111121117774411111111177774421117767755677771115
 555557755555777771115555522244666111144111111551441111
 3377777755111111114447733377333114137777733377777777777
 77777125324
 00001313232344 666666444643556676677767544577677565566666
 5653366665454677677567765346767776677667676453432516
 4567756575765653342242255211677223 677777 6767576666
 77666215315
 000013094554365654556546235556565564665665653555456665666632
 2665565466565343456543545554556553435554565664577777211
 7777744455622565755444566444556557777655655454777655567
 77733322275
 0000130511 131 11333111 11 11 1145222333 112224452224442233
 342224455563345673334663664552455663562554652544562532221554
 66224354556335 1233113445 1667334334 16666663333566674675
 67467217315
 000013001211111123312 244 455222356 3443443343433423
 45 45555344466455233566555 23334434232222321211211221
 22355333444122 133 122122 133344 231336766776
 77343224213
 0000129311 1 3235556245456 256675 65 6567 566 75675675564
 56334 776775674674456777777566456567357456456567256145 1
 4514746734713513435 14 467 567345345 34257456 14656 5 5
 567221144
 00001290111144111223111111261114675551112342342344564564555
 552236676665555566666666622266666246456555552342222466
 6666666661111155555551116663333311166666666666666666666
 66666117247
 00001286556322111222555111553355564445544444467733333226
 4411177667556667221122777771122267766767577777772224575
 6756633456644411122211111115664466611166666111777777777
 77777212113
 00001285111 11 11111111111115663311111242777643243222
 2111126615611112211122111122 1113311133313122 1
 11111 221 33321111 222666 1224336666
 66366323143
 00001283111322111221244222421155477766432777776566663552
 2553532563654677766643364644634433322111667311756256677224
 2277777777557666672114443137777777636777655311433777777
 77656224214
 00001282121232 121 12111132111222111233221121222332
 3211144433222123212123334434434334334311134434334411233 1
 2123223233312111 11112114213233343 2 32131233 213542433555
 65555214313
 000012792325541223442216325435214433223221115436555444335436
 44643655767766766554655766655546556664436547676664434335547
 66655654555544432543322655433654432433322777766666655777767
 77766215312

000012743331321114571441113561115674776771565667774775772776
 772546775773774772663554664552225775771775676772551461441773
 77577366246144111111113111777234333122577771111414767775
 77777224334
 000012682422531216662431222542435665652551116766664553453654
 6532366565652446566624356566244222454365666555661445551323
 54666233465333222433111566122465232565112224651114652225665
 66565213315
 000012652442331113545561232432464572424561223555562332332345
 563555562563554674451234564563332345563424674455561222343566
 66667556666323122256555551245712222234356555124345554566
 67667216316
 000012633234562226664452324553324565565673325566774434344344
 36435545345456667444343767466332332445667656434667775467776
 676576776776674325437674446577776456454225456575346676676777
 77667311314
 00001261 3 142666223555562224333454554443454 53343453 55
 54 4544577 7777 6666655555657777744 6 5 5662242 34457
 77666676672 32 26663334442226 6111112 77777223777775567
 77777412213
 00001260 21242111443111 123 125 23 235 252542432431
 443333451115551111412437773442222311421215756654743746765741
 52256174576 32 34453 41332 32777256677 4 7777771116667777777
 77666414311

SPSSX Program for T-Test

TITLE THESIS RESEARCH
FILE HANDLE THESIS / NAME = 'sur.dat'
DATA LIST FILE = THESIS FIXED RECORDS = 3 /
SURVEYNO,X1,X2,X3,X4,X5,X6,X7,X8,X9,X10,
X11,X12,X13,X14,X15,X16,X17,X18,X19,X20,
X21,X22,X23,X24,X25,X26,X27,X28,X29,X30,
X31,X32,X33,X34,X35,X36,X37,X38,X39,X40,
X41,X42,X43,X44,X45,X46,X47,X48,X49,X50,
X51,X52,X53,X54,X55,X56,X57,X58,X59,X60,
X61,X62,X63,X64,X65,X66,X67,X68,X69,X70,
X71,X72,X73,X74,X75,X76,X77,X78,X79,X80,
X81,X82,X83,X84,X85,X86,X87,X88,X89,X90,
X91,X92,X93,X94,X95,X96,X97,X98,X99,X100,
X101,X102,X103,X104,X105,X106,X107,X108,
X109,X110,X111,X112,X113,X114,X115,X116,
X117,X118,X119,X120,X121,X122,X123,X124,
X125,X126,X127,X128,X129,X130,X131,X132,
X133,X134,X135,X136,137,X138,X139,X140,
X141,X142,X143,X144,X145,X146,X147,148,
X149,X150,X151,X152,X153,X154,X155,X156,
X157,X158,X159,X160,X161,X162,X163,X164,
X165,X166,X167,X168,X169,X170,X171,X172,
X173,X174,X175,X176,X177, GROUP
(F8.0,72F1.0 / 80F1.0 / 26F1.0)

SET BLANKS = 9 / WIDTH = 80
MISSING VALUES SURVEYNO TO X177 (9)

T-TEST GROUPS = grp (1,2) / VARIABLES = X3
T-TEST GROUPS = grp (1,2) / VARIABLES = X6
T-TEST GROUPS = grp (1,2) / VARIABLES = X9
T-TEST GROUPS = grp (1,2) / VARIABLES = X12
T-TEST GROUPS = grp (1,2) / VARIABLES = X15
T-TEST GROUPS = grp (1,2) / VARIABLES = X18
T-TEST GROUPS = grp (1,2) / VARIABLES = X21
T-TEST GROUPS = grp (1,2) / VARIABLES = X24
T-TEST GROUPS = grp (1,2) / VARIABLES = X27
T-TEST GROUPS = grp (1,2) / VARIABLES = X30
T-TEST GROUPS = grp (1,2) / VARIABLES = X33
T-TEST GROUPS = grp (1,2) / VARIABLES = X36
T-TEST GROUPS = grp (1,2) / VARIABLES = X39
T-TEST GROUPS = grp (1,2) / VARIABLES = X42
T-TEST GROUPS = grp (1,2) / VARIABLES = X45
T-TEST GROUPS = grp (1,2) / VARIABLES = X48
T-TEST GROUPS = grp (1,2) / VARIABLES = X51
T-TEST GROUPS = grp (1,2) / VARIABLES = X54
T-TEST GROUPS = grp (1,2) / VARIABLES = X57
T-TEST GROUPS = grp (1,2) / VARIABLES = X60
T-TEST GROUPS = grp (1,2) / VARIABLES = X63
T-TEST GROUPS = grp (1,2) / VARIABLES = X66

T-TEST GROUPS = grp (1,2) / VARIABLES = X69
T-TEST GROUPS = grp (1,2) / VARIABLES = X72
T-TEST GROUPS = grp (1,2) / VARIABLES = X75
T-TEST GROUPS = grp (1,2) / VARIABLES = X78
T-TEST GROUPS = grp (1,2) / VARIABLES = X81
T-TEST GROUPS = grp (1,2) / VARIABLES = X84
T-TEST GROUPS = grp (1,2) / VARIABLES = X87
T-TEST GROUPS = grp (1,2) / VARIABLES = X90
T-TEST GROUPS = grp (1,2) / VARIABLES = X93
T-TEST GROUPS = grp (1,2) / VARIABLES = X96
T-TEST GROUPS = grp (1,2) / VARIABLES = X99
T-TEST GROUPS = grp (1,2) / VARIABLES = X102
T-TEST GROUPS = grp (1,2) / VARIABLES = X105
T-TEST GROUPS = grp (1,2) / VARIABLES = X108
T-TEST GROUPS = grp (1,2) / VARIABLES = X111
T-TEST GROUPS = grp (1,2) / VARIABLES = X114
T-TEST GROUPS = grp (1,2) / VARIABLES = X117
T-TEST GROUPS = grp (1,2) / VARIABLES = X120
T-TEST GROUPS = grp (1,2) / VARIABLES = X123
T-TEST GROUPS = grp (1,2) / VARIABLES = X126
T-TEST GROUPS = grp (1,2) / VARIABLES = X129
T-TEST GROUPS = grp (1,2) / VARIABLES = X132
T-TEST GROUPS = grp (1,2) / VARIABLES = X135
T-TEST GROUPS = grp (1,2) / VARIABLES = X138
T-TEST GROUPS = grp (1,2) / VARIABLES = X141
T-TEST GROUPS = grp (1,2) / VARIABLES = X144
T-TEST GROUPS = grp (1,2) / VARIABLES = X147
T-TEST GROUPS = grp (1,2) / VARIABLES = X150
T-TEST GROUPS = grp (1,2) / VARIABLES = X153
T-TEST GROUPS = grp (1,2) / VARIABLES = X156
T-TEST GROUPS = grp (1,2) / VARIABLES = X159
T-TEST GROUPS = grp (1,2) / VARIABLES = X162
T-TEST GROUPS = grp (1,2) / VARIABLES = X165
T-TEST GROUPS = grp (1,2) / VARIABLES = X168
T-TEST GROUPS = grp (1,2) / VARIABLES = X171
T-TEST GROUPS = grp (1,2) / VARIABLES = X174
T-TEST GROUPS = grp (1,2) / VARIABLES = X177

SAS Rank Order Correlation

```
options linesize=78;
data ranks;
input milrank civrank @@;
cards;
 1 1 2 20 3 17 4 15 5 9 6 6 7 14 8 3 9 24
10 5 11 28 12 40 13 35 14 7 15 27 16 16 17 2 18 11
19 4 20 29 21 33 22 23 23 39 24 30 25 10 26 43 27 38
28 45 29 41 30 25 31 52 32 26 33 8 34 12 35 18 36 31
37 21 38 22 29 13 40 51 41 34 42 19 43 47 44 42 45 46
46 50 47 48 48 32 49 36 50 49 51 54 52 37 53 56 54 44
55 53 56 55 57 57 58 58 59 59
;
proc cancorr data = ranks all;
var milrank; with civrank;
title 'educational skills ranked by importance';
title2 'military & civilian rank order correlation';
proc print;
```

Bibliography

1. Air Force Institute of Technology. School of Systems and Logistics Annual Evaluation Report FY 85. Wright-Patterson Air Force Base OH, 1986.
2. Bell Communications Research Technical Education Center. 1987 Bellcore TEC Course Catalog. Product Promotion Group, Bell Communications Research, Inc., Lisle IL, December 1986.
3. Department of the Air Force. 1985 - 1987 Catalog. Air Force Institute of Technology. Wright-Patterson AFB OH, 1986.
4. Department of the Air Force. Civil Engineering General: Resource and Work Force Management. AFR 85-1. Washington: HQ USAF, 21 May 1982.
5. Department of the Air Force. Officer Personnel: Officer Classification. AFR 36-1. Washington: HQ USAF, 1 January 1984.
6. Devore, Jay L. Probability & Statistics for Engineers and the Sciences. Monterey CA: Brooks/Cole Publishing Company, 1982.
7. Dominowski, Roger L. Research Methods. Englewood Cliffs NJ: Prentice-Hall, Inc., 1980.
8. Donovan, John. "Plant Engineering at Digital Equipment Corporation," Plant Engineering, 40:28-33 (June 26, 1986).
9. Duncan, Captain Mike, Assistant Program Manager, Graduate Engineering Management. Personal interview. Air Force Institute of Technology, Wright-Patterson Air Force Base OH, 25 February 1987.
10. "Employee Training in America," Training and Development Journal, 39:34-37 (July 1986).
11. Freund, John E. Statistics: A First Course. Englewood Cliffs NJ: Prentice-Hall, Inc., 1970.
12. Gordan, Jack. "Where the Training Goes," Training, 23:49-63 (October 1986).
13. "A Guide for the Development of the Attitude and Opinion Survey," HQ USAF/ACM, Pentagon, Washington, DC, October, 1974.

14. International Facility Management Association (IFMA). Education Report, Facility Management Disciplines. IFMA Research Report, No 1. Arizona: IFMA Arizona Chapter, 1986.
15. Katzel, Jeanine. "Frito-Lay's Plant Engineering Strategy for the 1990s," Plant Engineering, 40:48-54 (August 28, 1986).
16. Klug, Thomas J., Marketing Manager. Personal interview. American Institute of Plant Engineers, Cincinnati OH, 20 February 1987.
17. Kocaoglu, Dundar F. "Engineering Management Education and Research," Paper Presented at the International Congress on Technology and Technology Exchange / Engineering Management Conference 84. 1-10+. 1984.
18. Porter, Lyman W. and Edward E. Lawler. Managerial Attitudes and Performance. Homewood, IL: R. D. Irwin, 1968.
19. Smith, J. Parke K., Captain, USAF, Personal Correspondence. Headquarters Air Force Military Personnel Center, Randolph Air Force Base TX, 20 February 1987.
20. "A Tale of Two Plants," Plant Engineering, 40:56-60 (11 September 1986).

VITA

Captain David M. Kreag was born on 14 June 1959 in Peru, Indiana. He graduated from high school there in 1977, and attended Purdue University, from which he received a Bachelor of Science Degree in Industrial Engineering in December 1981. After graduation, Captain Kreag was commissioned in the United States Air Force through the Officer Training School at Medina Annex, Lackland AFB, Texas, on 26 August 1982. His initial assignment was to K. I. Sawyer AFB, Michigan, where he worked as Chief of Industrial Engineering, 410th Civil Engineering Squadron. In August 1984, he was assigned to the 6112th Civil Engineering Squadron at Misawa Air Base, Japan, which was changed to the 432nd Civil Engineering Squadron shortly thereafter. He was again assigned as Chief of Industrial Engineering in charge of implementing a prototype Work Information Management System minicomputer until entering the School of Systems and Logistics, Air Force Institute of Technology, in May 1986. Captain Kreag's next assignment will be at Wurtsmith AFB, Michigan.

Permanent address: R. R. 5 Box 315 A

Peru, Indiana 46970

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188									
1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED		1b. RESTRICTIVE MARKINGS											
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited											
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE													
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AFIT/GEM/LSM/87S-14		5. MONITORING ORGANIZATION REPORT NUMBER(S)											
6a. NAME OF PERFORMING ORGANIZATION School of Systems and Logistics	6b. OFFICE SYMBOL (If applicable) AFIT/LSM	7a. NAME OF MONITORING ORGANIZATION											
6c. ADDRESS (City, State, and ZIP Code) Air Force Institute of Technology Wright-Patterson AFB OH 45433-6583		7b. ADDRESS (City, State, and ZIP Code)											
8a. NAME OF FUNDING/SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER											
8c. ADDRESS (City, State, and ZIP Code)		10. SOURCE OF FUNDING NUMBERS <table border="1"><tr><td>PROGRAM ELEMENT NO.</td><td>PROJECT NO.</td><td>TASK NO.</td><td>WORK UNIT ACCESSION NO.</td></tr></table>			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.					
PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.										
11. TITLE (Include Security Classification) See Box 19													
12. PERSONAL AUTHOR(S) David M. Kreag, B.S., Captain, USAF													
13a. TYPE OF REPORT MS Thesis	13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Year, Month, Day) 1987 September	15. PAGE COUNT 112										
16. SUPPLEMENTARY NOTATION													
17. COSATI CODES <table border="1"><tr><th>FIELD</th><th>GROUP</th><th>SUB-GROUP</th></tr><tr><td>13</td><td>08</td><td></td></tr><tr><td></td><td></td><td></td></tr></table>	FIELD	GROUP	SUB-GROUP	13	08					18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number) Education, Engineering, Facilities, Management			
FIELD	GROUP	SUB-GROUP											
13	08												
19. ABSTRACT (Continue on reverse if necessary and identify by block number) Title: AN INVESTIGATION OF EDUCATIONAL REQUIREMENTS IN FACILITIES ENGINEERING Thesis Chairman: Hal A. Rumsey, Major, USAF GEM Program Director					Approved for public release: 1AW7 AFIT 100-34. <i>Lynn E. Wolaver</i> 24 Sept 87 Lynn E. Wolaver Dean for Research and Professional Development Air Force Institute of Technology (AFIT) Wright-Patterson AFB OH 45433								
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED											
22a. NAME OF RESPONSIBLE INDIVIDUAL Hal A. Rumsey, Major, USAF		22b. TELEPHONE (Include Area Code) (513) 255-5023	22c. OFFICE SYMBOL AFIT/LSM										

UNCLASSIFIED

This research identified academic subjects considered important by facility managers in order to improve the Air Force's educational program on facility management. From the literature review, 59 academic subjects were incorporated into a survey to test for perceived need and importance. Two populations of facility managers were surveyed to compare military and civilian perspectives, using a 7-point Likert scale.

The results indicated that professional ethics was the single most important subject. Construction management, life cycle costing, leadership, technical writing, communication, statistical analysis, strategic planning, and public speaking were rated with means above 5 (important) by both military and civilian respondents. Seventeen other academic subjects were rated by either the military or civilian respondents as important. Of the 59 academic subjects, 35 (59 percent) showed no significant differences between the means of the military and the civilian respondents.

Twelve academic subjects not specifically included in the Air Force's Graduate Engineering Management curriculum were considered important by either the military or the civilian respondents: professional ethics, construction management, strategic planning, maintenance management, budget preparation, building fire protection, building programming, civil engineering, mechanical engineering, electrical engineering, safety engineering, and value engineering. Inclusion of these academic subjects may improve the overall program. They could be incorporated into already existing courses, or made available as additional elective courses in the GEM curriculum.

UNCLASSIFIED

END
FILMED
FEB. 1988
DTIC